



Association of Computer Users

1690 Thirty Eighth Street • Post Office Box 9003 • Boulder Colorado 80301 • 303/499-1722

C O N T E N T S

VOLUME 3.0 - BENCHMARK REPORT

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Update No. B8



ASSOCIATION OF
COMPUTER USERS

Volume 3.0

Dear ACU Member,

Thank you for subscribing to ACU's *BENCHMARK REPORT*.

The main value of this series is simply to help you narrow down your choices when considering small computer systems. Instead of each member "re-inventing the wheel" and analyzing each system from scratch, our intent is to provide you with valuable comparative information at a price which is far below the cost of doing the research yourself.

Of course, your own needs should dictate which system you ultimately choose, and we are specifically **not** endorsing or recommending any particular vendor or machine. The choice is yours; we only hope to help you by providing the only source of unbiased, user-oriented, benchmark information available today.

Sincerely,

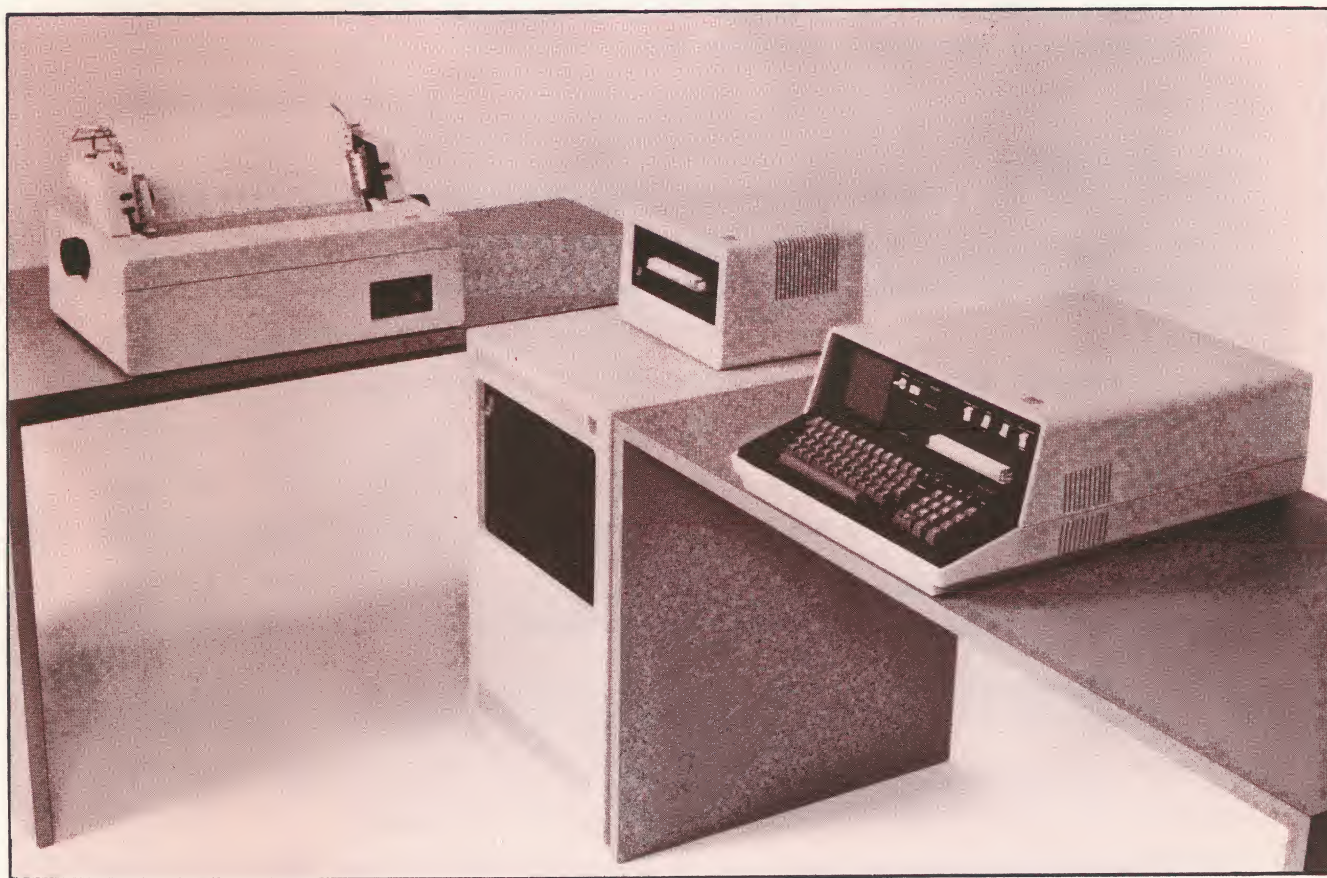
Hillel Segal, President

BENCHMARK REPORT



ASSOCIATION OF
COMPUTER USERS

VOLUME 1, NUMBER 1, NOVEMBER 1978



In This Issue:

The IBM 5110 Computing System

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IBM 5110: BENCHMARK REPORT

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PREFACE

This report on the IBM 5110 from Real Decisions Corporation (RDC) is the first in a series dealing with minicomputers currently being offered in today's marketplace. The purpose of this series of reports is to provide members of ACU with solid and objective information on which they can base their buying decisions.

All of the systems to be evaluated in this report series will be stand-alone desktop computers designed primarily for a single user. The reports will cover the alternate configurations which may be assembled -- central processing units (internal memory and computing power), I/O (ease of using the keyboard and proficiency of printers), capacities and types of external storage (diskettes and/or tapes), operating system and languages employed, and options available for other peripheral devices. Also addressed will be other crucial areas for decision-making -- software, costs, and support services.

The heart of each report will be a benchmark section based on five programs created and run by the RDC staff. These same benchmarks will be consistently run on each of the minicomputers evaluated. After each series of six reports is completed, a summary will be issued to analyze how the competitive minis compare with each other in benchmark results.

In addition, each report will feature observations by RDC on overall trends and comments from ACU members who are currently using the minicomputer being evaluated. These more subjective remarks will be included as an integral part of the separate discussions on each of the system's components. In this way, the "hard facts" and technical details of the product may be brought to life by the experiences of the "hands-on" users.

In short, the goal of this series is to provide users with reliable benchmark data -- data which is simply unavailable from any other independent source today.

EXECUTIVE SUMMARY

The IBM 5110 offers users of small computers a low-risk, dependable system for basic business needs. Although it is obviously too early to compare the 5110's benchmark results with the other systems which we plan to test, the following important characteristics stand out at this time:

- The 5110's use of double-density, dual-sided diskettes provides a dramatic improvement over its predecessor, the tape-only 5100 system.
- The use of a complete version of APL on the 5100 and 5110, along with the growing popularity of this language, has established a unique position for this small machine.
- Users are generally unhappy with the display screen - both its readability and size limitation of 64 characters per line. The 64-character limitation of input lines could cause substantial problems in writing and debugging programs.
- IBM's good reputation for reliability and service make the 5110 a "safe, low-risk" alternative for corporate decision makers. In large corporations, users are seldom criticized for "going IBM" (regardless of cost), but must often be prepared to take responsibility if non-IBM gear is chosen and something goes wrong.
- On the ease-of-use test, we rated the 5110 "very easy" although the text-editor was not able to handle global changes with ease.

As one of the most widely known small computers, the IBM 5110 will serve as a good basis of comparison as we test other similar machines in the coming months. The first challenger, the popular Datapoint 1170, will be benchmarked in our next issue.

BENCHMARK REPORT

SYSTEM: IBM 5110

PRICE AS TESTED: \$19,975

SPEED TESTS

Benchmark Number			TOTAL TIME	
			Min.	Sec.
<i>CPU INTENSIVE</i>				
A-1	N = 500			21.8
A-2	N = 1000			42.2
A-3	N = 2000	1	23.4	
A-4	N = 3000	2	04.7	
<i>I/O INTENSIVE</i>				
B-1	N = 500	2	31.4	
B-2	N = 1000	2	57.6	
B-3	N = 2000	3	47.4	
B-4	N = 3000	4	38.4	

"REAL LIFE" PROBLEMS

Benchmark Number			TOTAL TIME	
			Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	29	47.2	
C-2	NEW PRODUCT PLANNING		24.2	
C-3	ACCOUNTS RECEIVABLE	4	11.0	

EASE OF USE TEST

Benchmark Number			
E-1	NUMBER OF KEYSTROKES REQUIRED		200
E-2	SUBJECTIVE JUDGMENT	Very Easy (With limitations)	

THE BENCHMARK PROCESS

RDC utilized the 5110 configuration reported by the average user in our survey. All benchmarks were run on a 32K BASIC-only Model 2 processor, with one diskette unit (two drives) and a 120 cps printer. Equivalent configurations will be obtained from vendors of competitive systems as we continue this series of reports. Vendors, of course, are encouraged to run selected benchmarks in the language of their choice. IBM did not choose to make any runs in APL - for that matter, IBM did not even choose to review any of the BASIC programs prepared by RDC.

The benchmark programs were first evaluated for compatibility of BASIC support. I/O statements were the only ones that had to be changed and these were for syntax only, not function. Examples of statements requiring change were WRITEFILE, OPEN, CLOSE, MAT GET and MAT PUT. REREAD and REWRITE were not used by the benchmark programs but are available. The PRINT statement did not have to be changed since it defaults to the screen, the desired alternative for these runs. However, for hard copy the changes would have taken a considerable amount of time due to the 64-character limitation of an input line.

After ensuring that the alterations necessary for running caused no changes in output expected, the programs were loaded into the workspace and the stopwatch was readied. The execute key and the stopwatch were pressed simultaneously and when the results appeared on the screen, the stopwatch was stopped.

All jobs were run with results displayed on the screen. No hard copy was produced. However, at any time the user may press the HOLD key. This stops the computer and allows the user to print the current contents of the screen. Processing is resumed by depressing the HOLD key again.

All programs except the New Product Planning problem were run with the CRT display turned off during the processing and turned back on before displaying the results.

In addition, an Ease of Use test was run to determine the 5110's editing

capabilities. A file was created and edited according to a script, and the number of keystrokes required to get the desired result was noted.

Unlike many competitive systems, the 5110 is a packaged system with a limited set of options. The customer can vary CPU memory, tape and disk storage within prescribed boundaries, and he also has a choice of languages - BASIC and/or APL. Two printer options and two types of communications facilities complete the list of variations. We expect to be able to construct equivalent configurations from the 'do it yourself' kits available from many of the competitors. Thus, the 5110 becomes RDC's base line for future comparisons in this report series.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

'Real Life' Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs

through an iterative process N times, with 'N' values of 500, 1000, 2000 and 3000.

A-1	Results:	At N = 500	21.8 seconds
A-2		N = 1000	42.2 seconds
A-3		N = 2000	1 minute 23.4 seconds
A-4		N = 3000	2 minutes 04.7 seconds

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on disks and retrieves the first 50 of them in a factorial fashion (for example, for a total of 1275 reads following 3000 writes). Several combinations were run with 'N' values of 500, 1000, 2000 and 3000.

B-1	Results:	At N = 500	2 minutes 31.4 seconds
B-2		N = 1000	2 minutes 57.6 seconds
B-3		N = 2000	3 minutes 47.4 seconds
B-4		N = 3000	4 minutes 38.4 seconds

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of 'N' equations with 'N' unknowns:

$$\begin{array}{rcl}
 0.1x_1 + 0.1x_2 + 0.1x_3 + \dots + 0.1x_N & = & 0.2 \\
 0.1x_1 + 0.3x_2 + 0.3x_3 + \dots + 0.3x_N & = & 0.4 \\
 0.1x_1 + 0.3x_2 + 0.5x_3 + \dots + 0.5x_N & = & 0.6 \\
 \cdot & & \cdot \\
 \cdot & & \cdot \\
 0.1x_1 + 0.3x_2 + 0.5x_3 + \dots + 9.9x_N & = & 10.0
 \end{array}$$

To show that the run has been executed successfully, the values of x_1 , x_2 , and x_N are printed at the end of the execution.

C-1

Results: 29 minutes 47.2 seconds

Comment: The number of variables is 50, and the precision is 15 digits.

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A base line run is established, and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

-Units Sold	-Distribution
-Selling Price	-Gross Profits
-Revenue	-Fixed Costs
-Raw Material	-Net Before Taxes
-Direct Labor	-Taxes Payable
-Packaging	-Net Income

C-2

Results: 24.2 seconds

Comment: This is a typical example of a job that you might want to run using the HOLD feature to decide whether or not you want to get hard copy.

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C-3

Results: 4 minutes 11 seconds

Comment: *In order to illustrate the effect of the CRT on processing time, the update program was also run without turning off the CRT. The result was a loss of 21 seconds (i.e., it took 4 minutes, 32 seconds to run the series).*

EASE OF USE TEST

The Ease of Use test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string.

E-1

Results: Approximately 200 keystrokes were required to edit a 9 record test file according to script.

E-2

Comment: *The 5110 editor is very easy to use to correct typing errors because the erroneous character can be located quickly and over struck to effect the desired result. However, for a user working in a debugging mode, the editor would be much more limiting since there is no facility for making massive global changes to an entire file and no word processing capability.*

IBM 5110: PRICING COMPONENTS

COSTS

The IBM 5110 purchase price ranges from just below \$10,000 for a minimum BASIC system to more than \$27,000 for a large APL scientific system.

- No installation assistance is provided.
- A separate maintenance contract is available.
- A warranty period = 3 months + 10 days from time of shipping.
- A purchase pilot test plan is available; the contract period covers three months and costs about 15% of purchase price.

COMPONENTS ARE PRICED AS FOLLOWS:

	BASIC	APL	BOTH
16K	\$ 8,475	\$ 9,475	\$10,475
32K	10,225	11,225	12,225
48K	11,975	12,975	13,975
64K	13,725	14,725	15,725

Inboard Tape.....	\$1,400
Auxiliary Tape.....	1,850
Printer 80 cps.....	3,200
Printer 120 cps.....	3,700
Diskette(s).....	4150+1900+4150+1900*
Bisync.....	2,000
Asnyc.....	900

**Two diskettes are stored in one cabinet; the \$4150 represents the price of the first diskette drive in that cabinet, and \$1900 for the second drive.*

TYPICAL SYSTEMS QUOTED BY IBM ARE:

Small (16K, 1 Tape, 80 cps).....	\$13,075
Medium (16K, 2 Disks, 80 cps).....	17,725
Medium + (32K, 2 Disks, 120 cps).....	19,975
Large (48K, 4 Disks, 120 cps).....	27,775

USER COMMENTS

- ...significantly higher priced than competitors.*
- ...cheaper than time sharing.*
- ...has more than paid for itself already.*
- ...compact, convenient and expensive.*
- ...pretty good, but most certainly overpriced.*

IBM 5110: HARDWARE COMPONENTS

CENTRAL UNIT ... A portable desk-top unit of 43-50 lbs.

CPU Memory:	Choice of 16K, 32K, 48K, 64K
Keyboard:	Combined alphanumeric and numeric, full ASCII Separate 10-key calculator pad Ability for user to define own function keys
Screen:	1024 character display (16 lines of 64 characters) Ability to show half screen - either left or right half

OBSERVATIONS

Ease of portability of the unit dropped sharply with the addition of peripheral devices, and almost all the users keep the 5110 stationary.

Most users opted for the 32K memory and found it adequate for their needs. Of the two users who chose 64K, one was implementing APL and concerned about running out of memory.

The small screen was the most criticized 5110 feature, and more than half either have added or plan to add the large screen monitor.

If users had not added the large screen monitor, it was because they used the screen very little.

USER COMMENTS

- . The best feature of the 5110 is that it provides ample memory in a compact unit.
- . The limitation of 64 characters/line is frustrating; I wish it could be expanded to 72.
- . The large monitor screen was well worth the extra \$400.
- . Even a larger monitor didn't help the display.
- . A business machine should have a percentage (%) key - IBM personnel told me the 5110 doesn't have one.

IBM 5110: HARDWARE COMPONENTS

STORAGE

Model 1

Mag tape cartridge storage

Up to 204K bytes/cartridge

Optional: Diskettes

Auxiliary Tape Unit

Model 2

Diskettes only

Detail on Diskettes

- Each diskette stores 1.2M bytes of data, either sequentially or in a direct access mode.
- Each diskette unit houses 2 diskette drives, and the 5110 can accommodate up to 2 diskette units (a total of 4 drives).
- Diskettes are compatible with other IBM systems (System/1, System/32, System/34, 3741).
- Diskettes must be formatted before use.

OBSERVATIONS

Users split evenly between Model 1 and 2. However, all Model 1 owners used their tape option much less than the diskettes, and only half used the auxiliary tape unit. Only one Model 2 user indicated he would like to add the tape option.

Generally, most users were very pleased with the diskettes. Several users suggested hard disk storage as a feature they would like to add.

COMMENTS

- . *The diskettes make the difference between night and day when you compare the 5110 to the 5100.*
- . *Diskettes are much superior to tape - a lot can go wrong with the mechanical tape drives.*
- . *The diskettes provide a separate means of data entry and free up more CPU time - it's cut our work time by 30-40%.*
- . *The diskettes are certainly the best feature of the 5110. No one else has dual-sided, double-density disks.*

OTHER DEVICES

Printers: Choice of 5103-11 (80 characters/sec) or
5103-12 (120 characters/sec)

Options: Serial I/O - provides capability to attach peripheral devices
from non-IBM sources.

Parallel I/O - provides capability to attach up to
14 IEEE 488-1975 compatible devices.

Communications - Asynchronous - Up to 4800 baud
Bisynchronous

Audible Alarm - can be programmed to alert user to indicate error condition
and completion of tasks.

OBSERVATIONS

Slightly more than half the users chose the 80 cps printer and were satisfied with the results. One 80 cps user indicated he needed more speed - and of course he has the option of upgrading. No 120 cps users were dissatisfied.

In the I/O ratings, most users were very pleased with speed and ease of entry.

Not many of the users contacted chose to have the communication feature, but many of those who did not choose it still thought it was an important capability to have as an option.

A user cannot enter or execute programs when the 5110 is being used in the communications mode.

COMMENTS

- . The HP 250 was a close runner-up in our evaluation because of its printer control and DBMS features.
- . If I could add one feature, it would be a buffered, high-speed printer (300 lines per minute).

IBM 5110: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES & UTILITIES

Operating System: Control functions are integrated in the ROS (read-only storage) module.

Language: Choice of - BASIC, APL or Both (in ROS)

Available with either Model 1 or 2 at any memory size -

- 4400 of main memory set aside for BASIC
- 6700 of main memory set aside for APL

Utilities: Eleven utility functions are supplied -

LOADER

INITIAL - diskette initialization	COMPRESS - diskette compress
DDCOPY - diskette to diskette copy	LDISPLAY - label display
TDCOPY - tape to diskette copy	DRECOVER - diskette recovery
TTCOPY - tape to tape copy	TRECOVER - tape data recovery
DTCOPY - diskette to tape copy	HRECOVER - tape header recovery

Access Methods: There are two distinct types of data files which can be processed -- stream I/O and record I/O. Stream I/O can only be accessed sequentially. Record I/O files can be accessed sequentially, directly or with an index key.

OBSERVATIONS

Seven users surveyed chose BASIC-only, five chose the combination of both languages, and three chose APL-only.

COMMENTS

- The APL language is the best feature of the 5110.
- I don't know of any other mini which offers APL.
- APL has fantastic potential.
- The best feature for me is the ease of using interactive BASIC to modify my programs.
- The BASIC language, although improved from the 5100, is now "decent" but not really good.

IBM-SUPPLIED PACKAGES

Four libraries are available:

- Business Analysis/Problem Solver Library
 - 30 routines in BASIC only
- Math/Problem Solver Library
 - 44 programs in BASIC
 - 37 programs in APL
- STAT/Problem Solver Library
 - 41 BASIC routines
 - 40 APL routines
- Print Plot/Problem Solver Library
 - either BASIC or APL

There are four accounting packages:

- Dental Office Management System
- Client Accounting, Time Management
- Travel Agency Accounting System
- Mortgage Closing and Property Settlement System

Three specialized APL Packages are:

- APL Coordinate Geometry System (COGO) for civil engineering.
- APL GRAPHPAK for interactive graphics support of peripheral devices.
- APL Econometric Planning Language for working with economic variables.

OBSERVATIONS

Only half the users surveyed had purchased IBM-supplied software, mainly for the areas of financial reports, accounting, statistics and plotting. Specifically, the most-used IBM software packages were: regression analysis, general ledger, APL GRAPHPAK and APL STATPAK.

COMMENTS

- *Buyers, beware. Some other suppliers are marketing 5100 software for the 5110 - and it's not always compatible.*
- *I use the IBM-supplied APL STATPAK for statistics but BASIC for my bookkeeping.*

IBM 5110: SOFTWARE COMPONENTS

EDITOR

The Editor is cursor oriented. It uses a flashing underline to identify the character in question. The cursor is controlled by four separate keys for up, down, left and right. Positions pointed to by the cursor can be added to or deleted by two separate function keys. Entire lines can be deleted, replaced or added by using line numbers.

OBSERVATIONS

The 5110 accomplished line editing in the following manner: the cursor is positioned to a blank line, the line number to be deleted, added or replaced is typed along with the new text or the word 'DEL'.

Character editing is accomplished by positioning the cursor to the character in error. The scroll down key will move the text down, the scroll up key will move the text up, and the backspace or forward space key will move the cursor left or right respectively. The incorrect character is then replaced simply by keying the correct character over the incorrect character.

If deletion of a character is desired, the command key and the backspace key are pressed simultaneously; if insertion is desired, the command key and forward space are pressed before the insertion character is pressed. Pressing the ATTN key will delete all characters to the right of the cursor.

COMMENTS

- *I would like to improve the Editor so that it has the capability to perform text editing and word processing.*

IBM 5110: SUPPORT SERVICES

DOCUMENTATION

IBM 5110 BASIC Introduction (SA 21-9306)

IBM 5110 BASIC Users' Guide (SA 21-9307)

IBM 5110 BASIC Reference Manual (SA 21-9308)

IBM 5110 BASIC Reference Handbook (GX 21-9309)

IBM 5110 General Information and Physical Planning Manual (GA 21-9300)

IBM 5110 Computing System Setup Procedure (SA 21-9318)

IBM 5110 Customer Support Functions Reference Manual (SA 21-9311)

OBSERVATIONS

RDC's programmer/analyst was comfortable with all the documentation and rated the information supplied as complete and accurate. In general, however, the users interviewed rated documentation the lowest of all support services. It drew consistently low marks - with most ratings falling between "poor" to "barely satisfactory." Some users even nominated the manuals as their unfavorite 5110 feature. Only one user gave an "excellent" rating, and he said that was only because the 5110 manuals were so much of an improvement over the 5100 documentation.

COMMENTS

- . Manuals take a "patchwork" approach - they're put together over a period of time and never totally, comprehensively rewritten.
- . References are in so many places in so many manuals that you need a librarian to help you locate everything.
- . There's an overwhelming amount of literature and jargon.
- . It's incomplete - not one reference to bisynchronous communications, for instance, and no cross-references.

SUMMARY OF USER COMMENTS

Using names supplied by ACU, Real Decisions Corporation (RDC) contacted 15 of the persons who volunteered to participate in the 5110 Users' Survey. Most of these users rated their experience with the machine somewhere between "some" program execution with light modifications to "extensive" writing and running of programs. Respondents to the survey reside nationwide -- from New York to Nebraska, from Minnesota to Florida, from North Carolina to Arkansas.

The users' overall impressions of the 5110 varied from "fantastic" and "excellent" on the high side, through the middling range of "a very good, dependable tool" to "not overjoyed with it" at the bottom of the scale. Predictably, users' reactions depended in great measure on their prior computing experience and their current expectations.

In general, users for whom the 5110 is the first piece of computer hardware in the company -- or who have just upgraded from the 5100 -- are very pleased with their purchase. The 5110 is viewed as a tremendous time saver well worth the cost.

Comments from more experienced users -- those having a background in time sharing or large mainframes -- were still favorable, but generally less enthusiastic. This user contingent adopted a realistic view which characterized the 5110 (and other minis) as a "trade-off." That is, these users were well aware of the greater capabilities offered by larger equipment, but they opted for the minis because they offer on-site control and are cheaper than time sharing.

Generally, the 5110s are not standing idle, but are doing a variety of tasks for their owners. Used daily (and weekends too!) by from one to four persons, the 5110s log in between 2 to 12 hours per day.

In almost every case, the hard-working 5110 was rated "outstanding" as a very reliable, dependable piece of hardware. Downtime experienced has been minimal for many -- none for the majority. When small problems have occurred, users report that repair service has been swift and efficient. Only two users -- both based in New York City -- indicated that they were less than satisfied with IBM's service.

All respondents said they were using the 5110 for business applications, with only one user noting scientific use as well. No respondents reported use of the 5110 for scientific applications alone.

Specifically, users were developing programs for: financial planning and modelling, including cash flow and consolidations; data storage and retrieval; production scheduling and forecasting in manufacturing; sales listings and mailings; statistics and correlations; marketing research; portfolio and investments; inventory control.

Users of the APL language were very pleased with its flexibility and high potential, while the BASIC language received mixed reviews from the user community.

Had the 5110 users made an in-depth evaluation of other minis? A majority of those surveyed admitted that they had not. Some revealed that they had investigated other minis "cursorily," and a few stated that they had found comparable systems to be cheaper. However, IBM's back-up overruled the cost factor and won their purchase dollars. In fact, many named the "comfort" of IBM's service, support and assistance as the major determinant for choosing the 5110.

Competitors most often mentioned were DEC, Wang and Hewlett-Packard, followed by NCR, Honeywell, Texas Instruments, IMSAI, DataGeneral and Altaire. One user even volunteered that he personally rated the

capabilities of the HP mini as superior, but "the differential wasn't enough to overcome the political heat" placed on him to stay with an IBM product.

High on the list of "outstanding" ratings given by users were the diskettes, nominated by many as the "best feature" of the 5110. They were judged far superior than the tape units for external storage. Several users made the point that only IBM offers dual-sided, double density disks. Only one user said he thought the disks "still need work." A few users of large APL systems were concerned about running out of storage, and a hard disk option was named by several as a capacity they would like to see added.

The SORT feature was supposed to be hardwired in read-only storage (ROS), but a hardware bug developed. Currently the SORT option is a software feature on diskette, run by the UTIL SORT command. Future plans call for the IBM customer engineers to fix the hardware in the field.

Scoring lowest on users' ratings was the display screen, which half the users said was barely satisfactory. For some it was their least favorite feature of the computer. Only those who did not use the CRT display regularly withheld criticism. Many users who had not added the large screen monitor planned to do so to aid readability. In addition to poor readability, several users mentioned that the 64-character line was a limitation that they would like to see expanded to at least 72 characters/line.

In the service and support area, documentation received the most criticism from the users. Many seemed overwhelmed by the proliferation of manuals, multiple references and the lack of cross-referencing. It would appear that the old standard reading/writing communication skills are lagging behind our technological advances.

CONCLUSIONS

In conclusion, the IBM 5110 offers users of small computers a low risk, dependable system for basic business needs. RDC personnel accustomed to the IBM way of handling data were able to slide very comfortably into operating the 5110. Those users upgrading from the 5100 tape-only system are immediately impressed by the dramatic improvement in storage offered by the double-density, dual-sided diskettes - a technological capacity currently provided only by IBM. The diskettes were most often mentioned as the 5110's "best" feature.

Although it is obviously too early to compare the 5110 with comparable systems, several characteristics appear to stand out at this time. The 5110 has both the BASIC and APL languages - the predecessor 5100 was the first computer of its kind to offer a complete version of APL. With the popularity of this language growing rapidly within a dedicated group of both scientific and business users, a unique position has thus been established by IBM.

Many special function keys are provided for one-stroke operations like LOAD, REWIND, SAVE and LIST. We particularly liked the automatic line numbering which happens to be a function key - no line numbers need to be typed. Despite the many user complaints about documentation, we found it to be fine, no erroneous information and fully adequate for our purposes.

However, the 5110 is not without some problems. In general, users are not happy with the display screen - either its readability or its size limitation of 64 characters per line. The longer commands use up to 17 characters or more, leaving little space for the user's data, and since there is no provision for continuation to the next line, the same command again takes up space.

From our standpoint, the 64-character limitation of an input line presents substantial problems while debugging a program. In particular, preparation of hard-copy reports can take a considerable amount of time due to this limitation. We were happy to have already debugged the programs prior to encountering the 5110.

Hardware considerations aside, however, the main thing that IBM has going for itself in the mini field is its reputation for reliability and service. For this comfort factor, users are willing to disregard potential competitors and install the 5110. In the computer marketplace, you are seldom criticized if you "go IBM"; but, if you choose non-IBM gear, you must be prepared to take the responsibility if anything goes wrong. IBM, therefore, remains a "safe" alternative for many corporate decision makers.

For the independent consultant or self-employed businessman, however, the "big business" approach of IBM may be a minus rather than a plus. His individual call for attention may be too inconsequential to gain notice from the "giant." One discontented user in New York City complained bitterly about this kind of attitude and treatment by the sales and service personnel. Large corporations, of course, do not have this kind of problem due to their total potential for additional business.

Overall, we were impressed by the performance of the 5110 during the benchmark process. The New Product Problem, in particular, ran well ahead of our expectations. The editor was very easy to use for correcting specific errors. Our concern with the editor was related to the problem of making massive global changes to an entire file plus the lack of any word processing capability.

Subsequent tests on alternative hardware will determine the cost effectiveness of the 5110. As one of the most widely known small computers, it will serve as a good basis of comparison as we test other, similar machines.

NEXT ISSUE: THE DATAPOINT 1170.

BENCHMARK REPORT

Vol. 1, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members \$150/year, non-members \$190/year. Overseas subscribers add \$30 for airmail postage.

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ASSOCIATION OF COMPUTER USERS

P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 499-1722

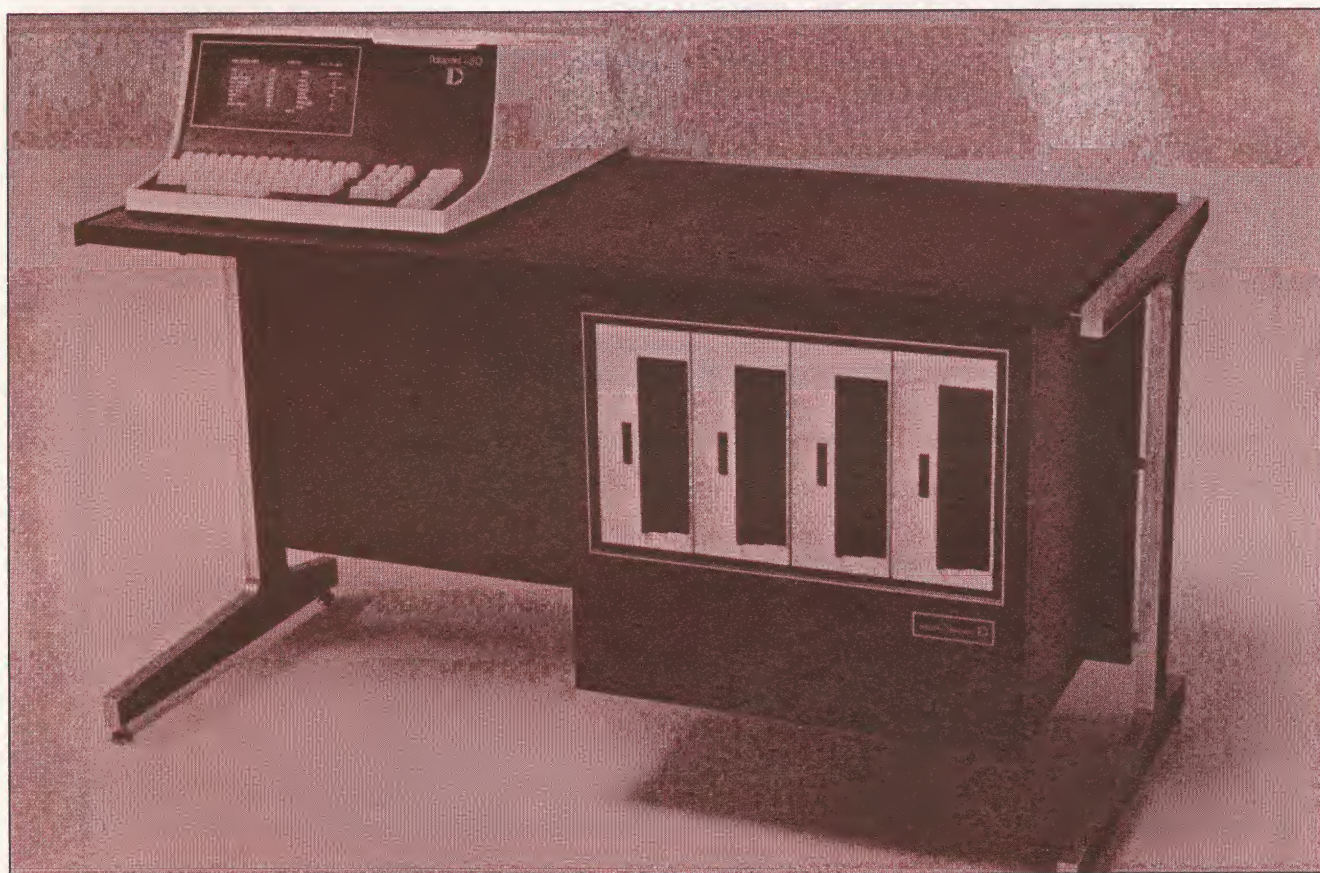
REAL DECISIONS CORPORATION

111 High Ridge Road
Stamford, Connecticut 06905
Tel. (203) 329-2071

BENCHMARK REPORT

ASSOCIATION OF
COMPUTER USERS

VOLUME 1, NUMBER 2, JANUARY 1979



In This Issue:

The DATAPOINT 1170

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DATAPOINT 1170: BENCHMARK REPORT

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PREFACE

The Datapoint 1170 is the second small computer to be studied by Real Decisions Corporation (RDC) for ASCU. The first Benchmark Report evaluated the IBM 5110, a minicomputer basically designed to be a stand-alone unit for the single user. This previous evaluation of the IBM 5110 now provides the base line for all future comparisons. Therefore, small computers such as the Datapoint 1170s, which are designed to operate both as separate units and/or as components of larger systems, will still be judged for the most part on their stand-alone capacities.

The purpose of these Benchmark Reports is to provide members of ASCU with solid and objective information on the minicomputers currently being offered in today's marketplace. The heart of each report is a benchmark section based on five programs created and run by the RDC staff to test the capabilities of each small computer.

Additionally, each Benchmark Report offers detailed pages on the hardware features, software components and support services available from each vendor. All components of the computer are fully examined to enable the user to develop a sense of the alternate configurations and to answer key questions on the particular features that are most important for specific types of applications.

These and other important considerations are also addressed by RDC by means of a survey of users who have experience with the small computer being researched. Their judgments and comments are included right along with observations from the RDC staff so that the report can speak from a wide spectrum of experience.

After each series of six reports is completed, a summary will be issued to analyze how the competitive minis compare with each other in benchmark results. With this comparative data -- data unavailable from any other independent source -- ASCU members can form educated opinions and make wise buying decisions.

EXECUTIVE SUMMARY

Datapoint's 1170 Series, comprised of a 48K processor and up to 4 diskette drives, offers users a very good way to "start small" in acquiring computing power, especially if the user desires the capacity to upgrade as his needs grow.

- Datapoint's 1170 is suited to the user who would choose flexibility above a dedicated single-purpose machine. Users who like to keep open all options can't go wrong with the Datapoint 1170, which is a member of a large family of compatible products.
- The Datapoint 1170 is rated excellent for users with a high requirement for data entry and file manipulation; however, the CPU would be too slow for users needing powerful number-crunching hardware.
- Users rate the "great abundance" of Datapoint software very highly, but prospective users are warned that the higher-level math functions (particularly exponentiation) are software implemented rather than hardwired - and therefore cannot compete with built-in capacities.
- According to the user survey, repair response time and field engineering are variable by locale. Users complain that service personnel lack expertise and repeatedly "fix symptoms, not causes"; and others report that Datapoint fails to provide a good local supply of parts.
- Datapoint computers are characterized as "extremely friendly" - rather easy to learn and to use quickly, but also capable of complex work.

Just as the IBM 5110 demonstrated the strengths of a small computer developed basically as a stand-alone, single-user machine, Datapoint's 1170 showed us the strong points of a multi-purpose, upwardly-compatible small computer.

The next issue of Benchmark Report will add the Wang 2200VP to our series.

BENCHMARK REPORT

SYSTEM: DATAPOINT 1170

PRICE AS TESTED: \$20,330.00

SPEED TESTS

Benchmark Number			TOTAL TIME	
			Min.	Sec.
CPU INTENSIVE				
A-1	N = 500	.....	1	19.2
A-2	N = 1000	.....	2	36.5
A-3	N = 2000	.....	5	05.7
A-4	N = 3000	.....	7	33.0
I/O INTENSIVE				
B-1	N = 500	.....	1	23.0
B-2	N = 1000	.....	1	40.3
B-3	N = 2000	.....	2	14.7
B-4	N = 3000	.....	2	47.5

"REAL LIFE" PROBLEMS

Benchmark Number			TOTAL TIME	
			Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	.....	38	27.5
C-2	NEW PRODUCT PLANNING	.....		17.3
C-3	ACCOUNTS RECEIVABLE	.....	6	50.4

EASE OF USE TEST

Benchmark Number		
E-1	NUMBER OF KEYSTROKES REQUIRED	.....	170
E-2	SUBJECTIVE JUDGMENT	.....	Very Easy

THE BENCHMARK PROCESS

All benchmarks were run in the BASIC language on a Datapoint 1170, which incorporates a 48K processor with diskette storage. The particular configuration used was the Datapoint 1172 (two diskette drives) plus an 80 cps printer from Datapoint's Freedom Printer line. Datapoint Corporation, fully cooperative in all ways from the outset of the benchmark project, availed RDC the use of this configuration at Datapoint's local Stamford, Connecticut office.

As a first step, the benchmark programs were evaluated for compatibility of BASIC support. For the most part, only the I/O statements required changes. All I/O had to be done via some variations of either an INPUT or a PRINT statement. A file must be closed and reopened before it can be read again.

Datapoint's support for formatted PRINT statements was one area that was particularly confusing and difficult to convert. Although the statements were functionally compatible with those of other BASIC implementations, Datapoint's version allowed two contradictory syntaxes for formatted PRINT - one was "PRINT USING mask variable" and "PRINT mask USING variable." This necessitated much debugging and experimentation before several of the benchmark programs could be run. The RDC analyst never did ascertain whether the documentation or the implementation was responsible for all the confusion. Another limitation of the formatted PRINT was that the masks had less function (e.g., no zero suppress was available; and there was no duplicating factor for masks).

After ensuring that the alterations necessary for running caused no changes in output expected, the programs were loaded into the workspace and the stopwatch was readied. The execute key and the stopwatch were pressed simultaneously and when the results appeared on the screen, the stopwatch was stopped.

All jobs were run with results displayed on the screen. No hard copy was produced. The CRT screen was put on HOLD by keeping the DISPLAY key pressed; however, the 1170 has no facility for creating hard copy from the "frozen" screen without rerunning the program. A user may, however, change easily from screen to printer and vice versa by setting a variable at the beginning

of a program. In addition, an ease of use test was run to determine the Datapoint 1170's editing capabilities. A file was created and edited according to a script, and the number of keystrokes required to get the desired result noted.

Unlike the pre-packaged IBM 5110 system, the Datapoint 1170 is designed to be part of a mix-and-match, compatible set of computing equipment. Therefore, if any limitations were encountered by the RDC analyst, Datapoint personnel were disposed to suggest a different additional unit to overcome the problem. This open attitude towards flexible use of equipment made it necessary for RDC to reemphasize that we were benchmarking primarily to test stand-alone systems.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

'Real Life' Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs

through an iterative process N times, with 'N' values of 500, 1000, 2000 and 3000.

A-1	Results:	At N = 500	1 minute 19.2 seconds
A-2		N = 1000	2 minutes 36.5 seconds
A-3		N = 2000	5 minutes 5.7 seconds
A-4		N = 3000	7 minutes 33.0 seconds

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on disks and retrieves the first 50 of them in a factorial fashion (for example, for a total of 1275 reads following 3000 writes). Several combinations were run with 'N' values of 500, 1000, 2000 and 3000.

B-1	Results:	At N = 500	1 minute 23.0 seconds
B-2		N = 1000	1 minute 40.3 seconds
B-3		N = 2000	2 minutes 14.7 seconds
B-4		N = 3000	2 minutes 47.5 seconds

Comment: When this benchmark was run at the 3000 parameter by Datapoint on a 48K processor with a hard disk, the resulting time was dramatically reduced to 1 minute 48 seconds.

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of 'N' equations with 'N' unknowns:

$$\begin{aligned}
0.1x_1 + 0.1x_2 + 0.1x_3 + \dots + 0.1x_N &= 0.2 \\
0.1x_1 + 0.3x_2 + 0.3x_3 + \dots + 0.3x_N &= 0.4 \\
0.1x_1 + 0.3x_2 + 0.5x_3 + \dots + 0.5x_N &= 0.6 \\
&\vdots \\
&\vdots \\
0.1x_1 + 0.3x_2 + 0.5x_3 + \dots + 9.9x_N &= 10.0
\end{aligned}$$

To show that the run has been executed successfully, the values of x_1 , x_2 , and x_N are printed at the end of the execution.

C-1

Results: 38 minutes 27.5 seconds

Comment: *The number of variables is 50, and the precision is 12 digits. In Datapoint's BASICPLUS, variables must be initialized before use.*

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A base line run is established, and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

-Units Sold	-Distribution
-Selling Price	-Gross Profits
-Revenue	-Fixed Costs
-Raw Material	-Net Before Taxes
-Direct Labor	-Taxes Payable
-Packaging	-Net Income

C-2

Results: 17.3 seconds

Comment: *One feature that is absent is the ability to capture output on the CRT screen and then proceed to hard copy without rerunning.*

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C-3

Results: 6 minutes 50.4 seconds

EASE OF USE TEST

The Ease of Use test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string.

E-1

Results: Approximately 170 keystrokes were required to edit a 9 record test file according to script.

Comment: The DOS Editor allows a great deal of text editing with minimal keystrokes.

DATAPOINT 1170: PRICING COMPONENTS

COSTS - General

In general, Datapoint lists a wide range of buy, lease and rent options for all equipment offered. Some points to note on pricing are:

- . Shipping costs are not included.
- . Lease prices do not include maintenance.
- . Minimum installation charge ranges from \$125 to \$250 on all equipment except DATASHARE terminals and communications adaptors, where the range is \$60 to \$120.
- . Datapoint publishes specific terms for making upgrades of leased equipment.
- . Datapoint peripherals can only be leased as a part of a system which includes a processor.
- . Rentals are available on a minimum 90-day initial term basis.

COSTS - Specific

In the Datapoint 1170 series, all three models use the 5500-type processor (48K memory) and vary in price according to the number of diskette drives needed:

	<u>LIST</u>	<u>LEASE</u>			<u>RENT</u>	<u>MAIN.</u>	<u>INSTALL.</u>
		<u>1 yr</u>	<u>2 yr</u>	<u>3 yr</u>			
<u>Model 1172</u> DP 1170, 48K 2 diskette drives	\$15,980	\$416	\$384	\$371	\$520	\$74	\$125
<u>Model 1173</u> DP 1170, 48K 3 diskette drives	\$16,580	\$444	\$409	\$394	\$555	\$90	\$125
<u>Model 1174</u> DP 1170, 48K 4 diskette drives	\$17,180	\$472	\$434	\$417	\$590	\$110	\$125
<u>Printer:</u> Freedom 80 cps (Parallel inter- face)	\$ 4,350*	\$150	\$134	\$125	\$188	\$32	\$125

*Based on these list prices, the Datapoint configuration used to run the RDC benchmarks would cost \$20,330.

USER COMMENTS

...a decisive factor.

...very reasonable.

...a little cheaper than competitors.

CENTRAL UNIT ... Of the ten processors offered by Datapoint, the 1170 series uses the 1170 Dispersed Processor, which incorporates all the features of the 5500 Advanced Business Processor except cassette tapes. It weighs approximately 47 lbs.

CPU Memory: 48K for user
Additional 4K of ROM

Keyboard: Standard typewriter, 55 keys
11-key numeric pad (numerals 0-9 plus decimal)
5 control keys
Audio tones

Screen: 7" x 3.5", green on black
80 columns x 12 rows
960 ASCII characters
Upper and lower case plus special characters
5 x 7 dot matrix

OBSERVATIONS

The screen is a good size and very readable. The green-on-black display was mentioned by several users as a real eye-saver.

Although the processor's memory was 48K, only 17K was available to the RDC programmer - the rest was taken up by the system (DOS.C) and language (BASIC PLUS).

USER COMMENTS

- *The molded keyboard allows great ease of data entry and comfort for the operator.*
- *A calculator pad with a decimal is an improvement over the more usual 10-numeral pad.*

DATAPOINT 1170: HARDWARE COMPONENTS

STORAGE

The Datapoint 1170 series offers from two to four diskette drives:

Model 1172 - 2 drives
Model 1173 - 3 drives
Model 1174 - 4 drives

Detail on Diskettes

- Each diskette stores 256,256 characters, netting the user 1M characters of storage at the upper level (4 drives).
- Diskettes are IBM-compatible.
 - Software formatted disks are interchangeable with IBM 3741 diskettes.
 - A software utility program can convert Datapoint diskettes to IBM format.
- DOS is compatible with other utilities such as SORT and ISAM.
- Separate console or free-standing diskettes units are available. One drive costs \$3800, with increments of \$600 per drive, up to \$5600 for the 4-drive unit.

OBSERVATIONS

It takes four Datapoint diskettes to approach the storage capacity of one IBM diskette: four Datapoint diskettes (1M bytes of data) vs. one IBM "dual-sided, double density" diskette (1.2M bytes of data).

Most users interviewed were using hard disks in a multi-processor system configuration.

USER COMMENTS

- *From a distributor of Datapoint equipment: Diskettes will seem slower - don't overburden them. They're best for a stand-alone system and not advisable in a multitube environment.*
- *The restriction of a 256K diskette is the worst feature of the 1170 series.*

OTHER DEVICES

Printers: Datapoint offers a wide selection of impact printers that range from 30 cps to 600 lpm and appear identical, except for speed, to Datapoint software.

Some examples are:

Freedom Models

- 9231 - 80 cps - serial interface
- 9232 - 80 cps - parallel interface
- 9235 - 160 cps - serial interface
- 9236 - 160 cps - parallel interface

300 LPM Models (single channel)

- 9280 - 64 characters
- 9281 - 96 characters

600 LPM Models (single channel)

- 9260 - 64 characters
- 9261 - 96 characters

132 Column Belt Model

- 9212 - 115-240 lpm
- 9214 - 230-240 lpm

Options: Datapoint Card Reader - 80 column punched cards with optical sensor

Datapoint Peripheral Switching Devices - permit I/O cables to be switched from one device to another without disconnecting and reconnecting cables

Communications: Asynchronous Models

- 9400 - General Purpose - 9600 baud maximum
- 9401 - With Modem - 450 baud maximum
- 9402 - With Modem - 1800 baud maximum

Synchronous Models

- 9404 - General Purpose - 4800 baud maximum
- 9481 - Multifunction - 40,800 baud maximum

OBSERVATIONS

The mix-and-match offerings of Datapoint - all compatible for upgrading - enable users to configure their installations to meet individual requirements.

Throughout all the user interviews, RDC found not one user who was employing the exact configuration (Datapoint 1172) used in the RDC benchmarks.

USER COMMENTS

- *The plug and unplug options are what I consider the best feature offered by Datapoint.*
- *Flexibility in peripherals lets me tailor the equipment to my requirements.*

DATAPOINT 1170: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES & UTILITIES

Operating System: DOS.C Memory Required - 16K

Languages: Choice of - BASICPLUS, COBOL, RPG II, DATABUS, DATASHARE, DATAFORM, SCRIBE, Assembler, MULTILINK

Access Methods: Direct, indexed and sequential access methods are available for files.

Utilities: An extensive number of DOS Utilities is offered by Datapoint. Particularly designed for the 1170 is Utility DCDFMT - which provides compatibility between Datapoint and IBM 3741 diskette formats.

Some other DOS Utilities are:

AUTO	APP	FILES	SAPP
BACKUP	AUTOKEY	FIX	SUR
CAT	BUILD	FREE	UTILITY/SYS
CHAIN	DUMP 93X0	INDEX	UBOOT
CHANGE	KILL	REFORMAT	BOOT
COPY	LIST	SORT	CTOSDC
DOSGEN	MANUAL	COPYFILE	DCTAPE
DUMP	MIN	CHARINTL	DCTEXT
ENCODE	MOUT	DC BACKUP	FIXREL
DECODE	NAME	DC INCRD	INDEXMOD
INIT 9370	PUTIPL	REPAIR	DOSEPT
ABTONOFF	PUTVOLID	REWIND	LGOPROG

OBSERVATIONS

Almost all users interviewed were depending on Datapoint's own languages - DATABUS, DATASHARE and DATAFORM. COBOL was employed more than BASIC.

Any user of the Datapoint 1170 will discover that the Operating System has significant overhead.

USER COMMENTS

- . Datapoint's utility software is excellent - no one does it better.
- . The fast SORT is really good.
- . I find the BASIC and DATASHARE software remarkably bug-free.

DATAPOINT - SUPPLIED PACKAGES

- Operating Systems
 - DOS.C - Diskette Operating System
 - DOS Partition Supervisor - controls CPU for multiple users
- Languages
 - BASICPLUS - RPG II - DATASHARE
 - DATABUS - SCRIBE - Assembler
 - COBOL - DATAFORM - MULTILINK
- Utilities (listed on previous page)
- Editors
 - EDIT - DOS General Purpose Editor
 - BLOKEDIT - Text File Block Editor
 - EDITMOD - Enhanced DOS Editor
- Others
 - DATAPOLL - communications package that provides ability to transfer files from one processor to another
 - DATAACCOUNTANT - business and accounting packages available by license only
- ARC (Attached Resource Computer) Software - The 1170 Series can participate in a Datapoint ARC system, which creates a multi-processor environment that is able to be extended and upgraded in a modular fashion. This capability enables the user to increase files and/or applications processing or storage power selectively on an as-needed basis.

OBSERVATIONS

Datapoint has an extensive number of software packages available for purchase or licensing. BASICPLUS, for instance, costs \$500 for a permanent license fee; and the DOS.C package costs only \$20 to buy.

MULTILINK is a system capability that enables the user to employ the 1170 as a super-intelligent terminal to communicate with another terminal or a host computer.

USER COMMENTS

...provides a great abundance of very flexible software.

...DATAFORM is fantastic for our needs.

...a leader in software and growth.

DATAPoint 1170: SOFTWARE COMPONENTS

EDITOR

Datapoint supports two separate editors:

- The BASICPLUS Editor - a line-oriented editor which is easy to learn and use, but limited to editing one line at a time.
- EDITMOD - the enhanced DOS Editor - a cursor-oriented editor which is also easy to learn and use but much more powerful.

OBSERVATIONS

The BASICPLUS editor cancels lines with one keystroke (CANCEL). Lines can also be backspaced over and cancelled, but only before entering. Deletions can be made on several inclusive lines. Modifications can be made to text one line at a time.

The EDITMOD (Enhanced DOS Editor) uses an arrow on the left-hand side of the screen to point to the edit line. Both the text and the pointer can be scrolled up or down by various separate and simultaneous depression of the DISPLAY and KEYBOARD keys.

Some of the commands available for use are INSERT, DELETE, COPY, MODIFY and LOCATE. The user may also define and execute his own commands. The use of a pseudo-enter character allows pre-definition of a series of commands that can then be entered as one multiple command by ENTER.

This editor also "remembers" the last command executed so that the user does not have to retype a command when the pointer is set to a new line.

USER COMMENTS

- *The DOS Editor allows a great deal of text editing with minimal keystrokes.*
- *EDITMOD is really sophisticated.*

DOCUMENTATION

All software and documentation can be ordered through the local sales office or the Software Distribution Center in San Antonio.

User Guides for all the DOS Utilities have a separate price tag of \$15-\$20.

Guides used by RDC Staff were:

- Datapoint DOS BASICPLUS User's Guide
- Disk Operating System (DOS) User's Guide
- Enhanced DOS Editor (EDITMOD) User's Guide

MAINTENANCE

Datapoint provides a central 800 number (located in Houston) to handle calls for repair. A daily trouble list is telecommunicated to each customer engineer location. (Customer engineers carry beepers with them to keep in touch.) If a trouble call is not resolved the same day as it is reported, it is flagged when the daily trouble list is sent out.

OBSERVATIONS

Users interviewed were generally satisfied with the documentation except for a few complaints about a "time lag" in receiving up-to-date material.

Satisfaction with repair seemed dependent on locale. Prospective customers were advised to check out the local situation with current users before contracting with Datapoint.

USER COMMENTS

- *They seem to fix symptoms, not causes.*
- *Response is good, but expertise lacking.*
- *They check urgency of the problem immediately and then handle well.*

SUMMARY OF USER COMMENTS

Using names supplied by ASCU and Datapoint Corporation, RDC interviewed 13 Datapoint users by telephone. Although we specifically requested customers who were using the Datapoint 1170, we actually had to settle for talking to a wide range of users - users who were employing everything from an 1100 processor (16K memory) to those who had the top-of-the-line ARC system (numerous processors linked together to build a powerful facility).

Datapoint users are people who obviously like a many-optioned, multipurpose environment. They take great relish in mixing and matching the numerous Datapoint offerings to tailor them to their individual needs. Therefore, it was consistently difficult to separate the 1170 configuration from the rest of the Datapoint equipment so that the users' comments would relate specifically to the 1170. As a result, this summary reflects more generalized views about Datapoint equipment as a whole rather than the 1170 as a separate entity.

In general, users seem to be satisfied with their decision to use Datapoint. Not surprisingly, the word "flexible" cropped up most often as users reported their general impressions of Datapoint equipment. Other general opinions cited the equipment as "reliable" and "above average." One knowledgeable user characterized Datapoint's equipment as "extremely friendly" - easy to learn and to use rather quickly - but also able to handle complex work well.

Heavy use was reported by the majority of Datapoint respondents. Most users were employing Datapoint for business applications, but a higher number reported scientific usage in comparison to the IBM 5110 survey. The scientific areas mentioned were clinical and pharmaceutical data collection.

One respondent using both scientific and business applications said his equipment was "very good" for business but "not so good" for scientific use. The only hardware drawbacks cited specifically by 1170 users were lack of CPU speed and the limitations of the 256K diskette for storage.

Specific applications reported were: inventories, receivables, accounting,

mailing lists, orders, projections, statistical analysis, report printing, data collection and retrieval, marketing and education. Several users mentioned Datapoint's file handling capabilities as their candidate for the "best feature" of the equipment.

In the language choices, the BASIC PLUS used to run the RDC benchmarks was only lightly used by the interviewees, who chose to program in Datapoint's own DATABUS or DATASHARE language for most of their applications. COBOL was also mentioned as a significant language option - in fact, for two users the availability of the COBOL compiler was the decisive factor in their evaluative process.

Viewed as a "leader in software" by all its users, Datapoint Corporation's software catalog lists an extensive number of software packages in programming languages, operating systems, utilities and communications. The "great abundance" of flexible and compatible software was cited by many as an important factor in choosing to go with Datapoint equipment.

Most of the Datapoint users had evaluated the competition before deciding on their Datapoint equipment. The three competitors most often mentioned were Data General, Four Phase and Sycor; others were Hewlett-Packard, Basic Four, DEC, General Automation, Entrex, Data Sciences and IBM (by an ARC user).

Overall, Datapoint users believe that the cost of their equipment was reasonable; for some, cost became a decisive factor when comparisons showed that Datapoint was a little cheaper than the competition.

In the area of service and support, Datapoint users presented a mixed picture. Documentation was generally categorized as satisfactory - with some reservations. There were complaints about the difficulty of getting up-to-date material - the "time lag" experienced in receiving new manuals. On the high end of the ratings, however, a pleased user said that the DATAFORM guide was the "single best piece of documentation" he'd seen in a long time. One user reported all manuals as "excellent" except for COBOL, and another said the range in his opinion was variable - from "beautiful" to "terrible" - and

wished for more "how to" sections.

Spotty results occurred in the maintenance ratings as well. On the high end, one ARC user reported "great ease" in moving an installation from one site to another - it was recabled and running within three hours! Also, another long-term user said he found Datapoint responded quickly to check the urgency of the problem and then handled it well. A DP Manager rated Datapoint's hardware as "better than CDC or IBM" in down time.

Comments from the dissatisfied users, however, pointed to corporate trouble in providing a good local parts stock and questions about the "expertise" (or lack of) demonstrated by the field engineers. One user commented that the repair personnel "fix symptoms, not causes." Another added that field repair had trouble determining if problems were either hardware or software related. Two users made the point that maintenance support varied so greatly between locales that prospective buyers of Datapoint should make a careful assessment of their local situations.

CONCLUSIONS

Comparing the Datapoint 1170 to the IBM 5110 benchmarked in the first report was a more difficult task than expected. While the IBM 5110 is a true stand-alone unit designed with the single user in mind, the whole emphasis of the Datapoint Corporation is to present the 1170 as one member of a fully-integrated family of hardware and software products.

The Datapoint 1170 is best suited for those who rate flexibility and multi-purpose use high on their list of small computer requirements. It provides a good means of initiating in-house computer power in a small way, while still retaining the capability to upgrade and expand without losing past development efforts. Datapoint prides itself on supplying compatible "plug and unplug" hardware components and fully-integrated software options.

Users should be aware, however, that in some areas they pay a price for such flexibility and multiple options. Although the Datapoint software line is abundant and versatile, it cannot compete with built-in capacities offered by some other small computers. For instance, the higher level math functions such as exponentiation, being software implemented, tend to consume much more CPU time than comparable hardwired functions. Therefore, users with high calculation requirements would find the 1170 processor to be slow for their needs.

Another negative noted by the RDC analyst about Datapoint's multi-purpose concept was that the software-implemented operating systems and languages consumed so much CPU memory that the user had little workspace left for programs.

However, on the plus side, a look at the benchmark results for the I/O runs reveals the Datapoint 1170 to have superior qualities for data entry and file manipulation. In the RDC survey of users, those whose applications are predominantly I/O oriented named this capability as Datapoint's "best feature."

The user remark that stands out from the RDC survey is the characterization of Datapoint equipment as "extremely friendly." Across-the-board end users agree that Datapoint equipment is particularly approachable - easy and quick to learn for inexperienced users. Our own analyst commented on the ease of implementation and singled out the comfortable molded keyboard as a user-oriented feature worth mentioning.

As a group, the Datapoint users interviewed by RDC could be categorized as "adventurous" - willing in the initial stages to test the small computer market by evaluating competitive offerings, and then disposed to experiment with the multitude of options provided to customize Datapoint's hardware/software products to their special requirements. They seemed to enjoy having a variety of choices rather than a dedicated, single-purpose system. And the users were convinced that they were getting the most computing power for their money.

NEXT ISSUE: THE WANG 2200VP.

BENCHMARK REPORT

Vol. 1, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members \$150/year, non-members \$190/year. Overseas subscribers add \$30 for airmail postage.

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ASSOCIATION OF COMPUTER USERS

P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 499-1722

REAL DECISIONS CORPORATION

111 High Ridge Road
Stamford, Connecticut 06905
Tel. (203) 329-2071

BENCHMARK REPORT

ASSOCIATION OF
COMPUTER USERS

VOLUME 1, NUMBER 3, FEBRUARY 1979



In This Issue:

The WANG 2200VP

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WANG 2200VP: BENCHMARK REPORT

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PREFACE

The Wang 2200VP is the third small computer to be evaluated by Real Decisions Corporation (RDC) for ASCU. RDC's two previous reports assessed the IBM 5110 and the Datapoint 1170 - both critiqued as stand-alone systems. This criterion will also apply to the Wang 2200VP and all future minicomputers in this Benchmark Report series.

The purpose of these Benchmark Reports is to provide members of ASCU with solid and objective information on the minicomputers currently being offered in today's marketplace. The heart of each report is a benchmark section based on five programs created and run by the RDC staff to test the capabilities of each small computer.

In addition to the benchmark programs and results, each Benchmark Report attempts to answer questions that a prospective user would pose when considering the purchase of a minicomputer. Each issue supplies detailed pages on hardware, software, support services, and pricing components. Armed with this information, a user can determine whether or not his needs find a good match within the configuration discussed.

Another important facet of this series is the sampling of opinion elicited by RDC's user survey. Sales brochures and other vendor publications can supply a base of important information, but only references from the field can address the common concerns and problems that users face in dealing with a minicomputer and its company's personnel in the everyday work environment. Frank commentary from current users alerts prospective users to many considerations which otherwise tend to be overlooked.

After each series of six reports is completed, a summary will be issued to analyze how the competitive minis compare with each other in benchmark results. With this comparative data -- data unavailable from any other independent source -- ASCU members can form educated opinions and make wise buying decisions.

EXECUTIVE SUMMARY

Wang's 2200VP processor, supported by one to three diskette drives, provides users with a system which has two significant strengths; processing speed and high-level support of mathematical functions.

- The Wang 2200VP offers outstanding number-crunching abilities to the user who needs large complex calculations done in record time with high speed and precision.
- Many users think of the Wang 2200VP as a programmer's dream machine. They cite many Wang features which give programmers a great deal of control, almost at the systems programming level. Among the hardware features cited are the 32 special function keys, which can be programmer-defined; the great ease of writing and debugging programs, as well as the "fantastic" ease of making program modifications; and the well-supported BASIC language interpreter hardwired in ROM.
- Users who are accustomed to having most file handling done for them will find that the 2200VP will be weak in meeting these kinds of expectations for data management. Most users with high requirements for file handling overcame this weakness by having customized programs created for them by software houses.
- Once again, repair services received mixed reviews from the users - categorized by some as the "best" feature and by others as the "worst." Overall, down time was not reported as a significant problem; but for users who needed service, a repair often took two to three days in some locales.

In general, Wang as a company is considered "viable" - an outfit that "takes a lot of pride in its minis." The philosophy adopted by Wang emphasizes the hardware tools necessary to do the job. Therefore, Wang concentrates on developing its technology to the highest degree possible.

The next issue of Benchmark Report will add the Hewlett-Packard System 45 to our series.

BENCHMARK REPORT

SYSTEM: WANG 2200VP
PRICE AS TESTED: \$20,700.00

SPEED TESTS

Benchmark Number	TOTAL TIME	
	Min.	Sec.
<i>CPU INTENSIVE</i>		
A-1 N = 500		02.5
A-2 N = 1000		05.0
A-3 N = 2000		09.6
A-4 N = 3000		14.2
<i>I/O INTENSIVE</i>		
B-1 N = 500	1	45.4
B-2 N = 1000	2	10.7
B-3 N = 2000	-	--
B-4 N = 3000	-	--

"REAL LIFE" PROBLEMS

Benchmark Number	TOTAL TIME	
	Min.	Sec.
C-1 SCIENTIFIC/ENGINEERING	2	05.8
C-2 NEW PRODUCT PLANNING		01.2
C-3 ACCOUNTS RECEIVABLE	3	20.0

EASE OF USE TEST

Benchmark Number		
E-1	NUMBER OF KEYSTROKES REQUIRED	165
E-2	SUBJECTIVE JUDGMENT	Very Easy

THE BENCHMARK PROCESS

All benchmarks were run in the BASIC language on a Wang 2200VP processor with a 32K memory and a disk workstation which housed three diskette drives. Wang shipped these components plus a Model 2231W printer (120 cps) to RDC's Stamford, Connecticut office to expedite the benchmarking process.

Wang's disk I/O access was quite unfamiliar to the RDC analyst, in that some variation of PRINT or WRITE, READ or INPUT was not acceptable. Instead, Wang syntax required commands such as DATASAVE and DATALOAD.

Wang's BASIC language is well-supported, with many enhancements not usually available with standard BASIC - particularly in the area of matrix operations. In addition, there is an enhancement called the General I/O Instruction set, which is used to write customized I/O control routines with a programmable I/O electronic signal sequence. Thus, a user can control Wang peripherals which are not supported by BASIC or control non-Wang peripherals which have been specifically interfaced to a Wang system.

In the area of file handling and data management, the user discovers that each write to the disk takes up a whole sector, no matter how large or small. Therefore, in order to make most efficient use of the disk, the user must plan out blocking and deblocking routines for every file created. On the other hand, the user who is interested in having the ultimate in efficient I/O has available BASIC statements which allow disk storage to be addressed at the absolute sector level.

To cite another slightly awkward aspect, a program which has been SAVED on a disk and then modified cannot be SAVED again over the original one under the same name. It must first be SCRATCHED from the disk before it can be SAVED again. Also, if the modified program is larger than the first time it was SAVED, it must be SAVED under a new name.

In a similar fashion, once the user has created a disk file in a BASIC program and then discovers an error, the program cannot be rerun without scratching the data file and changing the BASIC statement which created the file.

After ensuring that the alterations necessary for running caused no changes in output expected, the programs were loaded into the workspace and the stopwatch was readied. The execute key and the stopwatch were pressed simultaneously and when the results appeared on the screen, the stopwatch was stopped.

To change the I/O devices (e.g., screen to printer), a SELECT statement is issued. All jobs were run with results displayed on the screen. No hard copy was produced. Whenever it was necessary to freeze the screen, the HALT key was depressed.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

'Real Life' Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with 'N' values of 500, 1000, 2000 and 3000.

A - 1	Results:	At N = 500	2.5 seconds
A - 2		N = 1000	5.0 seconds
A - 3		N = 2000	9.6 seconds
A - 4		N = 3000	14.2 seconds

Comment: Results of these four runs show the superior speed of Wang in the number-crunching area.

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on disks and retrieves the first 50 of them in a factorial fashion (for example, for a total of 1275 reads following 3000 writes). Several combinations were run with 'N' values of 500, 1000, 2000 and 3000.

B - 1	Results:	At N = 500	1 minute 45.4 seconds
B - 2		N = 1000	2 minutes 10.7 seconds
B - 3		N = 2000*	---
B - 4		N = 3000*	---

*This program could not be run as-is with parameters of 2000 or more because each write resulted in a whole sector being written (a poor management of disk space); therefore, the data file was larger than the boundaries of the disk.

Comment: When rewritten to block records with optimum blocking factor, speed and disk storage were improved dramatically:

At N = 500	30.9 seconds
N = 1000	34.8 seconds
N = 2000	42.3 seconds
N = 3000	50.1 seconds

However, this is not a legitimate comparison.

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This program solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of 'N' equations with 'N' unknowns:

$$\begin{aligned}
0.1x_1 + 0.1x_2 + 0.1x_3 + \dots + 0.1x_N &= 0.2 \\
0.1x_1 + 0.3x_2 + 0.3x_3 + \dots + 0.3x_N &= 0.4 \\
0.1x_1 + 0.3x_2 + 0.5x_3 + \dots + 0.5x_N &= 0.6 \\
. & . & . & . & . \\
. & . & . & . & . \\
0.1x_1 + 0.3x_2 + 0.5x_3 + \dots + 9.9x_N &= 10.0
\end{aligned}$$

To show that the run has been executed successfully, the values of x_1 , x_2 , and x_N are printed at the end of the execution.

C - 1

Results: 2 minutes 5.8 seconds

Comment: This result is faster by a factor of more than 10 compared to those reported previously for other minis.

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A base line run is established, and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

-Units Sold	-Distribution
-Selling Price	-Gross Profits
-Revenue	-Fixed Costs
-Raw Material	-Net Before Taxes
-Direct Labor	-Taxes Payable
-Packaging	-Net Income

C - 2

Results: 1.2 seconds

Comment: The screen was so fast when outputting this report that the user had to produce hard copy to get usable results.

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C.3

Results: 3 minutes 20.0 seconds

EASE OF USE TEST

The Ease of Use test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string
- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string.

E.1

Results: Approximately 165 keystrokes were required to edit a 9 record test file according to script.

Comment: EDIT RECALL is excellent to help minimize keystrokes.

WANG 2200VP: PRICING COMPONENTS

COSTS

The Wang Price List for the 2200T/VP/WS computing systems details costs by components rather than packaged systems.

Prices for the 2200VP system used by RDC were quoted separately as:

	<u>MODEL</u>	<u>DESCRIPTION</u>	<u>UNIT PRICE</u>	<u>MO. MAINTENANCE</u>
CPU	2200VP-8	32K Memory with 9 I/O slots	\$10,200.00	\$65.00
CRT Consoles	2226B	12" CRT (80 x 24) Keyboard console with controller	\$ 2,600.00	\$15.00
Mass Storage Peripherals	2270-2	.50 MB Dual Removable Disk- ette Drives	\$ 4,700.00	\$45.00
Line Printer	2231W-2	132 col./120 cps (12 pitch)	\$ 3,200.00	\$28.00
TOTAL =			\$20,700.00	

Users interested in paring this price could consider the following options:

- Less memory - 16K for \$8,000.00
- Smaller CRT - 64 x 16 for \$2,200.00
- Less storage - one diskette only for \$3,200.00

Consideration could also be given to the 2200T system, which can be configured for as little as \$14,000.00.

OBSERVATIONS

Since the price list is component-oriented, it is helpful to have the guidance of a Wang salesperson in explaining the available options. The price list provides no "typical systems" (CPU, CRT, disk storage and printer combined as packages) for the user's consideration.

USER COMMENTS

- *The IBM System 32 we investigated was twice as much and Wang still provided more in capabilities.*
- *The 2200VP had all the capabilities we needed and was 20% cheaper than the nearest competitor.*

CENTRAL UNIT ... A processor which measures 12.1" high,
14.5" wide and 21" deep and weighs 47 lbs.

CPU Memory: Choice of 16K, 32K, 42K, 64K

Keyboard: Typewriter-like alphanumeric (ASCII)
12 key mathematical operator pad
32 special function keys

Screen: Green on black, 12"
80 columns x 24 rows
Upper and lower case

OBSERVATIONS

All users interviewed were more than satisfied with the CRT display, even when they were using the smaller 64 x 16 screen.

All the hardwired features give users a large memory for their programs.

A step upward in computing power is the 2200MVP, which can support up to eight terminals and 16 jobs concurrently in a multi-programming environment.

USER COMMENTS

- *The keys on the keyboard are styled like those on an old manual typewriter.*
- *Since the keys are not molded, typing becomes uncomfortable after a few hours of entry work.*

WANG 2200VP: HARDWARE COMPONENTS

STORAGE

Users of the Wang 2200VP have a choice of one to three diskette drives:

<u>Model</u>	<u>On-Line Storage Capacity</u>
2270-1 (Single)	262,144 bytes
2270-2 (Dual)	524,288 bytes
2270-3 (Triple)	786,432 bytes

Detail on Diskettes

- o Model 2270A diskette drive series allows any 2200VP to use IBM 3740 type diskettes by means of the 3740 Diskette Compatibility Software.
- o When formatted (initialized), the diskette tracks are divided into sectors with unique, randomly accessible addresses.
- o The 64 tracks on a Wang diskette are divided into 16 sectors with 256 bytes per sector, providing a storage area for 262,144 bytes of information.

OBSERVATIONS

About half of the survey respondents were using diskettes, with the other half using hard disks. In the hard disk area, the Model 2280 Fixed/Removable Disk Drives were particularly mentioned. These provide a single 13.4 megabyte removable platter as well as fixed storage from 13.4 to 67 megabytes.

Disks can be addressed at the absolute sector level by using eight BASIC statements.

USER COMMENTS

- *File handling in the Wang 2200VP is more software-oriented and therefore weaker - my candidate for the "worst" feature.*
- *The access speed of the disk is superior to many other minicomputers.*

OTHER DEVICES: (Selected from large offering)

Printers: Model 2221W Matrix Printer (132 columns)
 Model 2231W Line Printer (112 columns)
 Model 2261 High Speed Line Printer

Typewriters: Model 2201 Output Writer
 Model 2202 Plotting Output Writer

Plotters: Model 2212 Analog Flatbed Plotter
 Model 2232A Digital Flatbed Plotter
 Model 2272-1, -2 Digital Drum Plotter

Communications: Model 2227B Asynchronous Telecommunications
 Model 2228B Bisynchronous Communications Controller

Other: Controllers - I/O Interface, Scanning Input Interface
 Punched Card and Punched Tape Readers
 Digitizer and Auxiliary Display

OBSERVATIONS

Wang offers an unusually large and varied number of compatible peripherals.

When speaking of repair problems, users were apt to complain most often of a mechanical breakdown in the printer - named by some as the "worst" feature of their system.

USER COMMENTS

- *The hardware is totally plug-oriented - easy and convenient to use.*

WANG 2200VP: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES & UTILITIES

Operating System: System 2200VP

Languages: BASIC-2 (only)

Access Methods: Sequential and direct
Absolute sector addressing

Utilities: Wang lists an extensive selection of utilities, particularly General Utilities I, II, III and Integrated Support Systems Utilities (ISS). In addition, utilities are offered for card readers, data entry, digitizers, diskettes, tapes, graphs and plotters.

OBSERVATIONS

The BASIC language is well-supported with many enhancements not usually available with standard BASIC, particularly in the area of matrix operations. Both multistatement lines and multiline statements are allowed.

Wang's General I/O Instruction set makes five new BASIC statements available to the user: \$GIO, \$IF ON, \$TRAN, \$PACK and \$UNPACK. In addition, other BASIC statements allow disk storage to be accessed at the absolute sector level.

Mentioned most often by users as important utilities were KFAM 3, ISAM and ISS.

USER COMMENTS

- *I would like the BASIC language to offer an IF THEN ELSE command.*
- *Users really have to create their own data management by addressing disk storage at the absolute sector level.*

WANG-SUPPLIED PACKAGES

- Utilities (discussed on previous page)
- Commercial Packages:
 - Automotive Dealership Accounting System
 - Client Accounting System (CASH)
 - General Business System (GBS)
 - Life Insurance Illustration System
 - Management Planning System
 - Manufacturing Management System
 - Mortgage Management System
 - \$PARK (inventory and parts pricing)
 - TIME/CHECK (time and record keeping)
- Statistics Packages
 - Analysis of Variance
 - Non-Parametric Statistics
 - Regression Analysis
 - Sequential Analysis
- Medical Packages - patient billing and scientific
- Education Packages - computer-aided instruction, packaged courses, school accounting and reporting

OBSERVATIONS

Wang Laboratories has consciously chosen to develop only limited in-house software packages. Accordingly, Wang provides customers with a list of some 400 software houses that they approve and recommend for programming support.

Respondents frequently mentioned the local software houses that filled their needs for customized programs - particularly for file handling.

USER COMMENTS

- Wang is definitely not in the software business.
- The General Business Systems (GBS) package provides good "bread and butter" systems.

WANG 2200VP: SOFTWARE COMPONENTS

EDITOR

(The Wang Editor is mainly hardwired.)

WANG EDIT MODE - a cursor-oriented and line-oriented editor which uses an underline to identify the character in question.

The cursor can be moved horizontally one or five spaces to the left or right, to the beginning or end of the line in question; if the current text line occupies more than one line on the CRT, the cursor can also be moved vertically one line up or down. Positions pointed to by the cursor can be added to or deleted by two of the special function keys.

OBSERVATIONS

To enter the EDIT mode, the line number and the RECALL function key are depressed. The cursor may then be positioned by using one of the eight cursor movement function keys, and the corrected text may be entered.

Editing is accomplished in the following manner:

- If a line is to be added or replaced, the appropriate line number and text is keyed in, and the EXEC key is depressed.
- If a line is to be deleted, merely keying in the line number and depressing EXEC will do this.
- Depressing BACKSPACE will delete one character pointed to by the cursor and also moves the cursor left one character.
- ERASE will delete that portion of the line pointed to which is located immediately above and to the right of the cursor.

USER COMMENTS

- Line numbering is semi-automatic; depression of a key is necessary to obtain the next available line number.
- The variation of RENUMBER, which allows RENUMBERing out of order, is helpful in moving a group of statements from one part of a program to another.

DOCUMENTATION

Guides used by the RDC staff were:

- 2200VP Disk Reference Manual
- Programming in BASIC

Extensive Data Sheets are available for all components - CRTs, disk drives, line printers, multiplexers, communications controllers, plotters, and packaged systems.

MAINTENANCE

All service is dispatched from the local office, which has access to a full complement of spare parts. A regionalized structure provides both personnel and parts back-up for the local branches. If necessary, a Telex to the central corporate office effects immediate delivery of the required spare part, which is "traded" for the defective part.

A monthly maintenance contract is optional but highly recommended. Customers with maintenance contracts receive priority service.

OBSERVATIONS

Comments on both documentation and maintenance covered all the bases from excellent to "middling" to poor.

However, repair service stirred up more heated commentary than the area of documentation.

Wang's Data Sheets, noticeably technical rather than "sales-y" in approach, confirm Wang's technological and hardware orientation.

USER COMMENTS

- *The BASIC instruction manual is by far and away the best I've seen.*
- *I'd like to see some "how-to" diagnostics in the manuals for peripherals.*
- *Waiting two to three days for repair is not unusual.*
- *Service personnel provide a "spare part" rather than inconveniencing me while they repair the defective one.*

SUMMARY OF USER COMMENTS

Using names supplied by ASCU and Wang Laboratories, RDC made a telephone survey of 17 users. More than half the users had comparable 2200VP processors, while the others were using either the 2200T unit or the packaged WCS-20 or -30 configurations. Hard disks vs. diskettes use split about evenly.

Not one user interviewed was dissatisfied with the choice of Wang equipment. Without exception, users were complimentary when asked their general impression of their Wang gear; typical answers given were: "excellent," "the best piece of single user gear I know" and "super." "Dependable" and "reliable" were also chosen as descriptive words.

The most enthusiastic respondents were those users who loved to program. One user stated that the 2200VP was designed from a programmer's standpoint - obviously sympathetic to a programmer's needs. These were the respondents who named as "best feature" a variety of programming-oriented items: program control and protection; ease of programming and debugging; the hardwired BASIC language interpreter; "fantastic" ease of program modifications; the special function keys and the string instruction.

Programmers were generally pleased with Wang's BASIC language, described by most as "extremely powerful." One exception to this was a user who felt the BASIC language was "a little limited" because he favored adding some commands using the IF THEN ELSE construction. This same person said, however, that having BASIC in ROM made programming a joy. Editing was characterized as "absolutely great," with EDIT RECALL, TRACE and HALT STEP among the favorite commands used. Respondents particularly mentioned their satisfaction with Wang's software, specifically the SORT, ISAM and ISS utilities.

Reaction to documentation for the BASIC language was mixed. On the affirmative side, one user unequivocally stated that the BASIC instruction manual was "by far and away the best I've seen." Another user found that the manual was written "assuming a level of expertise in BASIC" that he did not have.

In the area of general commentary on the Wang's manuals and guides, one systems consultant with wide experience remarked that the documentation was "as bad as everyone else's - but has improved considerably." Another user who thought that many of Wang's manuals were good singled out the manuals for peripherals as "sparse," saying that they were in need of some good "how to" diagnostics for trouble-shooting. This same criticism was leveled by another user of scientific applications, who allowed that the initial programming books are good but in the area of technical information "they fall on their faces."

Not many users were expanding the standard BASIC language into other possibilities, like \$GIO or LINPUT, for example. One user who had tried \$GIO reported he was "not enamored" with it, and added that "it's more complicated than the average businessman would want to worry about." This same user also commented that \$UNPACK takes away some disk capability under program control.

Of all the users interviewed, only three were employing their systems for scientific rather than business applications. The scientific users cited applications such as heat, solar and electrical calculations; and engineering calculations using a plotter as a peripheral device. The business applications covered all the usual office requirements (accounting, billing, general ledger, payroll), many factory control needs (estimating, order scheduling, job costing, inventory, production), and miscellaneous others such as software development, circulation management, amortization and sales information. Most companies had one to six persons operating their Wang equipment, with daily usage varying from one to twelve hours per day.

In business environments, users who required a large amount of file handling had either written customized programs themselves or had contracted with a software house for such a program designed to accomplish the necessary data management. Several users commented that their Wang was "weak" in file handling capabilities, and one user cited file handling as his nomination for the "worst feature" of the 2200VP.

In contrast, many users pointed to the "tremendous math capabilities" as a real strong point of the Wang 2200VP. Those users who had upgraded from the 2200T were particularly impressed by the more powerful VP processor. Other "best features" named (in addition to the programming-oriented items previously mentioned) were the system's modularity, the straightforward and conceptually strong design, the cooperation and responsiveness of local repair services, the cost effectiveness of operating the system and the cost-competitiveness as compared to other small computers.

As in previous user surveys, the category of repair services elicited the widest range of commentary. Cited by some as the best feature and by others as the worst feature, service once again varied depending on user expectations and local practices. For example, one Midwest user reported his equipment had never been down more than two hours in three years; his experience has been that local service chooses to "provide a spare" until the defective unit is repaired, and therefore his operation is never inconvenienced. From the same area, another user said that the "preventative maintenance" provided by the local service group made a big difference in keeping his system operational.

In California and North Carolina, however, a different repair service picture emerges. There, users report a generally undermanned and understaffed situation, with a delay of two or three days in repair "not unusual." Perhaps a Massachusetts user's insight captures a bit of the truth: he believes Wang is growing so fast that it's hard for them to keep up their service.

Most Wang users had investigated the competitive marketplace. Named most frequently were DEC, IBM (System 3), NCR and Basic Four. Others mentioned were Hewlett Packard, Datapoint, Quantel, Data General, Honeywell and Burroughs. One firm even hired an independent consultant to verify their inclination to buy a Wang, and the consultant reported Wang to have all the required capabilities at a price 20% below the nearest competitor.

OTHER DEVICES:

Printers:

- HP2631A Serial Printer
 - 180 cps, bidirectional
 - 128 character ASCII (optional European characters)
 - standard, expanded or compressed lines
- HP2608A Line Printer
 - 400 lpm; graphics mode option
 - standard (132 characters) or expanded (66 characters) lines
- HP9871A Character Impact Printer
 - 30 cps, bidirectional
 - 96 character interchangeable print disk
 - 132 characters standard line length; 10 characters/inch

Communications:

- 45102A Asynchronous Serial Interface
- REMOTE/250 Capability
- HP250/HP3000 Data Link

OBSERVATIONS

All users surveyed had the 2631A Serial Printer as part of their configuration. One user suggested adding a guide to the printer ribbon to cut down on static problems.

Three users were considering adding the remote terminal capability.

USER COMMENTS

- *If we go to multi-terminals within 4-5 years, we will stay with HP but may change systems.*
- *Installing the first remote terminal really costs \$8-9,000.**

**due to the one-time investment required for interface hardware.*

HP250: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES & UTILITIES

Operating System: OS250

Language: HP Business BASIC

Access Methods: Sequential, Direct, Direct Word Access

Utilities: (Selected)

INIT - Formats a disk medium for use on the HP250, purges all files on an old medium.

DUPL - Copies the contents of one storage medium to another of same type.

CONFIG - Reviews or edits the system software memory usage, default peripheral addresses and system autostart.

ROUTIL - Assigns programs as run-only file type.

CATBIN - Provides access file information from the catalog header within a program.

OBSERVATIONS

HP's BASIC was the most comprehensive of any used by the RDC analyst during this series. BASIC statements allowed access to data base software, alternate character sets, programmable special function keys (softkeys), and CALLable subroutines. Structured programming (IF THEN ELSE, etc.) is now supported, as well as TRACE capabilities for program debugging. Even a random number generating capability is included.

USER COMMENTS

- *The operating system and ease of programming are the most important features for me.*
- *HP's version is about as extensive as BASIC has gotten.*

HP-SUPPLIED PACKAGES

The following software is supplied by Hewlett-Packard as part of the 250 system:

- IMAGE/250 - provides data base management capabilities
- QUERY/250 - allows access of data base information for retrieval, update and/or modifications
- FORMS/250 - provides the utilities that allow development or modification of customized forms
- REPORT WRITER/250 - formats reports to user needs
- SORT/250 - enables a program to access an IMAGE data base in a hierarchical fashion

The following two packages are offered by HP to OEMs for modification and distribution. HP is not staffed to support individual users of these packages.

- MFG/250 - provides for capture and maintenance of data on parts, their uses, inventory status and cost
- OM/250 - provides facility for order entry, accounts receivable and sales analysis

OBSERVATIONS

Users surveyed were taking a three-fold thrust method on software: self-developing, developing through OEMs and making good use of the HP-supplied packages. All three ways seemed to be working out well.

USER COMMENTS

- *I recommend the management software (IMAGE/250) to everyone.*
- *The key is software - there's plenty of good hardware out there.*

HP250: SOFTWARE COMPONENTS

EDITOR

Within the BASIC environment editing is cursor-oriented with no global change capability. Editing is eased by eight display editing keys. In addition to the 24 lines on the screen, HP has a scrolling buffer which will utilize any otherwise unused memory.

OBSERVATIONS

To create BASIC programs, lines are typed in starting with a line number. After each carriage return the interpreter checks syntax and rejects all non-BASIC entries unless entered as remark lines.

Five cursor control keys bring the cursor to the proper lines when making changes: up, down, right, left, home (upper left corner). The four directional keys may be used in a shifted mode, which moves the cursor five spaces horizontally or a full page up or down.

Three keys save keystrokes in making changes:

- CLEAR - clears the current line, waits for new entry (shift CLEAR erases the entire display from the cursor to the bottom)
- DELETE - deletes a character or an entire line (shifted)
- INSERT - allows for adding characters until pressed again. Shift INSERT places the cursor in position to insert a line.

USER COMMENTS

- All operations are easy on the 250, including editing.
- The scrolling feature is good for editing long programs.

DOCUMENTATION

Manuals used by the RDC analyst included:

- Quick Reference (a collection of flip cards with basic explanations)
- BASIC Programming Manual
- System Operators Guide

Also included with system purchase are System Software Manuals:

IMAGE, REPORT WRITER, FORMS, QUERY, SORT.

MAINTENANCE

Hewlett-Packard offers three different maintenance agreements with varying coverage.

Basic Agreement (for most business needs)

- covers the machine for service requests made between 8:00 a.m. and 5:00 p.m. Monday-Friday.

Standard Agreement

- covers the period between 8:00 a.m. and 9:00 p.m. Monday-Saturday.

Extended Coverage

- provides around-the-clock seven days a week coverage.

For additional fees service may be obtained if requested during non-covered hours.

TRAINING

Individual OEM start-up and continuing support assistance will vary. Consult your local OEM for his arrangements. HP offers a five-day comprehensive introduction to 250 operations, aimed at OEMs and similarly qualified end users.

USER COMMENTS

- *Documentation is 20 times better than IBM's.*
- *In general, their maintenance is good. My "worst case" was next day.*
- *It must have cost HP two to three times as much to give the course than what I paid for it.*

SUMMARY OF USER COMMENTS

Using names supplied by Hewlett-Packard, RDC spoke with 14 users of the HP250 system. All users of this relatively new system had owned their units less than a year; without exception, all respondents were highly enthusiastic about their present usage of the system as well as future possibilities for expanding their applications.

When asked their general impression of the 250, the mildest response was "very pleased," but most replies were nearer the "absolutely thrilled" end of the scale. Prime remarks included points about the flexibility of the computer, the fact that the 250 is a "very nicely designed machine" and "more advanced in every way" than competitive minis. Most purchasers were convinced they had bought the "best human-engineered unit available."

In contrast to some former surveys, these opinions were based on quite thorough research. The HP users seemed to be cautious buyers who had carefully assessed competitive systems through personal investigation and inspection prior to committing their purchasing dollars. Mentioned most frequently as competitors to the HP250 were systems by IBM, Burroughs, Sperry Univac and Wang - with NCR, Olivetti, DEC and Data General also named by several users. In general, users characterized other vendors as "hodge-podge" and "not together" when compared to their dealings with Hewlett-Packard. "IBM is not friendly or flexible," said one user; another named Wang to be HP's "only real competitor."

In addition to a general feeling of confidence in Hewlett-Packard as a company, users specifically cited hardware superiority ("very well built and easily serviced") and software support ("the key is software - there's plenty of good hardware out there"). In particular, the data base software was given by several users as the "number 1" decisive factor to purchase their 250. "I recommend the management software to everyone," stated one user of the IMAGE 250 package.

Other important factors uncovered by the survey included: the upgradeability of the 250, especially the ability to add hard disk storage capacity; the program development capabilities and programming control offered by the system; the special function keys and the softkeys on the CRT unit ("they're beautiful"). A California user allied to show business echoed the feelings of others when he praised the visual appeal of the console - "it's classy looking."

All levels of users liked the programming and operation of the HP250. HP's implementation of BASIC seemed to meet the needs of beginners as well as usage by advanced programmers. While an experienced user was enthusiastic about the "really expanded BASIC with PASCAL-like features," a user new to programming reported that he was able to self-develop his application with no real difficulty. "Programming is a joy" and "debugging is great" were two enthusiastic comments.

Although the system's facilities are powerful, operation of the system was judged "so friendly it's unbelievable." Even to novice personnel with no computer background, respondents remarked how "very non-intimidating" the HP250 was, as well as being "so explicit you can't make a mistake." Along with this line of conversation, interviewees usually specifically mentioned the softkeys as a prime example of ease of use.

Because they viewed the 250 as such an approachable machine, many users felt that training was unnecessary - "the need for training is practically nil because the machine's so easy." However, those users who had taken the Hewlett-Packard course thought that it was "worth the cost." They reported that HP expended considerable effort - "it must have cost HP two or three times as much to give the course than what I paid for it." Other support areas such as documentation and maintenance also received excellent ratings from the users. A few people wanted to have the documentation enlarged "to cover all the extras" but most were satisfied with the manuals because they were "quite straightforward" and "well laid out." Meriting specific commendation was an HP publication for 250 users, Communicator 250, which supplies update information from HP as well as customers' contributions of utility programs. In general, the users felt they were being "well-advised" of new developments and solutions to any software bugs.

In the area of maintenance the majority reported minimal downtime after the initial shakedown process. For all users, the "worst case" response had been the next day, after HP had determined that the problem was not critical. In fact, the only area of dissatisfaction uncovered during the survey was that users were not completely happy with the diskettes, which were criticized as "not heavy-duty enough for long term usage."

Although some users had experienced the usual start-up problems, most considered their installation to be already successful - "we're beginning to see large benefits already." With their first applications operating successfully, users were looking forward to expanding their usage in the months to come. All users seemed to have great confidence in continuing development efforts either by themselves or through OEMs. Relationships with OEMs had been excellent from the time of installation onward; users praised the "all-hours commitment" of OEMs who made every effort to resolve problems. "OEMs are just as concerned and involved as HP itself."

In sum - whether the interviewee was an engineer, controller, president, treasurer or manager - he was pleased with his choice of the 250. "I paid more but I was confident that HP was the best."

CONCLUSIONS

With the HP250 system Hewlett-Packard has achieved the fine (but rare) blend of powerful and dependable hardware wedded to sophisticated systems software - all housed in an appealing unit designed with people in mind. The relatively new 250 looks and acts like an all-around winner.

Through years of experience in meeting the demands of the instrumentation field, HP has developed a standard of excellence which extends to their business computers. In the benchmarks run by RDC, the HP250 demonstrated this excellence by emerging as one of the front-runners in all the tests.

In addition to top-notch performance in the benchmarks, programming and operation of the 250 were also rated as outstanding by the RDC analyst. HP's Business BASIC has been enhanced about as much as possible; in the opinion of RDC's analyst, if you can think of anything which BASIC should cover, most likely it has already been implemented in the HP version. No wonder users commented, "Programming is a joy."

Couple this programming capability with the thoughtful "human engineering" which went into the design of the desk-console - and you have a system which invites more and more usage. Hewlett-Packard has provided for expanding usage through upgrade features such as memory additions, hard disk options and remote terminals. Specifically, users may add a maximum of 288K bytes of user-accessible memory, up to two hard disks (at 19.6M bytes each) and five remote terminals which may be linked to the main console for simultaneous operations.

Given the abundant system memory provided (128K bytes is the standard built-in memory when buyers choose 32K bytes of user-accessible memory), it is easy to envision extensive usage on this small but mighty computer. There is plenty of room to develop customized applications to use along with the popular data base management software that is delivered as part and parcel of the 250 system. The data base software offering (IMAGE/250) was named by several users as the decisive factor for buying the HP250. In addition to HP's software, OEMs are meeting other needs through their MFG/250 and OM/250 applications for manufacturing control.

Since the 250 has been marketed less than a year, many new users happily reported the feeling that they were "in on the ground floor" with their system. Installations were experiencing the flush of success that arises when start-up problems have been overcome, and more than one user stated he felt like "part of the development team" as applications work progressed with OEMs. User relationships with OEMs were unusually strong and trouble-free.

Users report that both Hewlett-Packard and its OEMs provide "A-one" supportive services in the areas of documentation, training and maintenance - the very areas which usually cause the most dissatisfaction in the user community. Such ongoing support continues to reinforce a user's decision to buy the HP250.

As with the HP System 45 (Benchmark Report, No. 4), Hewlett-Packard again offers a quality system that is well worth the higher price if you can afford it.

BENCHMARK REPORT

Vol. 1, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members \$150/year, non-members \$190/year. Overseas subscribers add \$30 for airmail postage.

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ASSOCIATION OF COMPUTER USERS

P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 499-1722

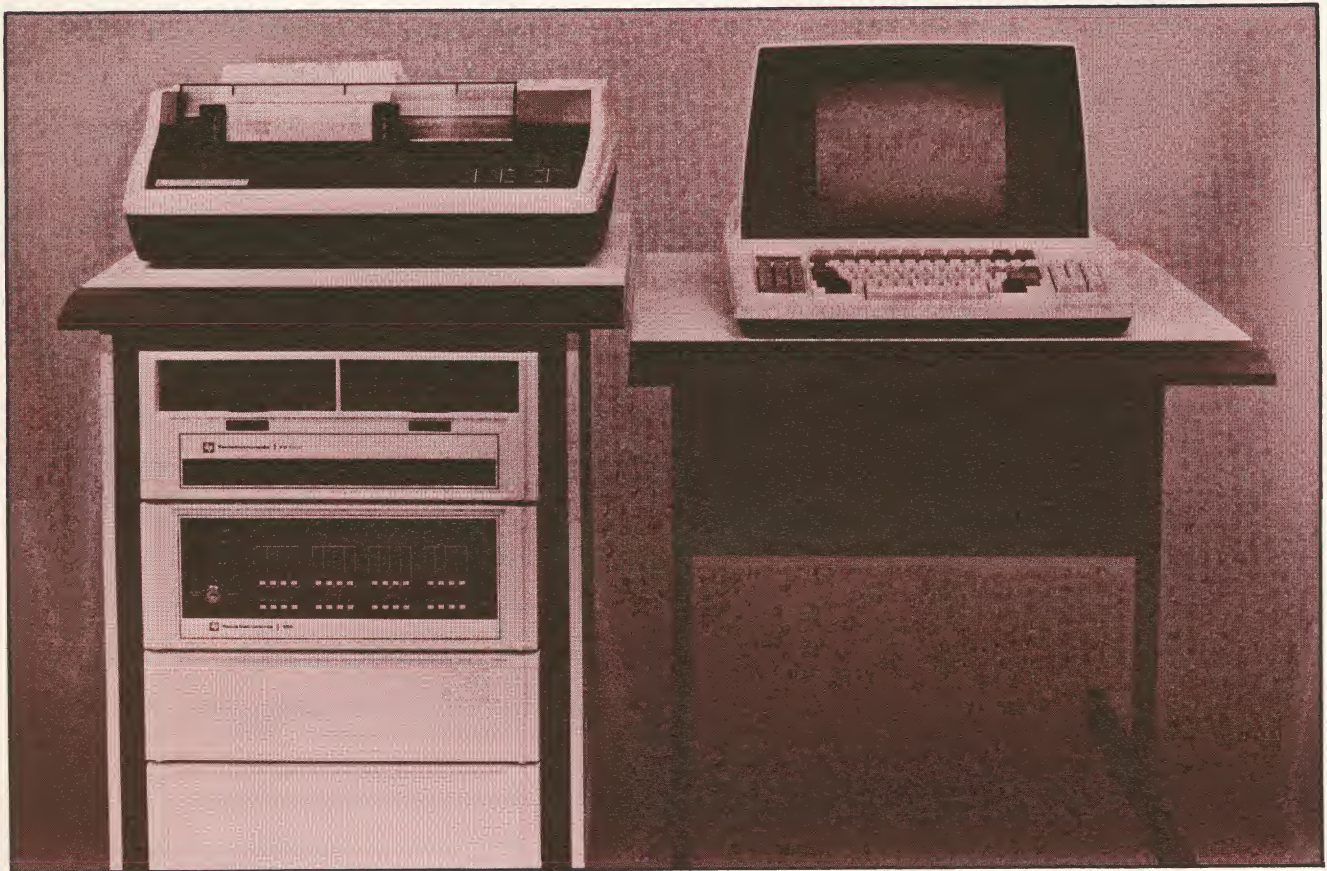
REAL DECISIONS CORPORATION

111 High Ridge Road
Stamford, Connecticut 06905
Tel. (203) 329-2071

BENCHMARK REPORT

ASSOCIATION OF
COMPUTER USERS

VOLUME 1, NUMBER 13, NOVEMBER 1979



In This Issue:

The Texas Instruments DS990 Model 2

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TEXAS INSTRUMENTS DS990 MODEL 2

BENCHMARK REPORT

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PREFACE

Last spring we published a report on Texas Instruments FS990/10, and this month's report returns us to that company for a look at a very new product - the DS990 Model 2 - which is just beginning to reach end users through TI's network of OEMs.

At this juncture, the twelfth and last issue of this series, it seems appropriate to re-examine the original concept of benchmarking as a tool for making comparisons between small computers. As a base line, we tested systems which were configured with the same basic hardware within a specified price range so that the comparisons would be fair. As issue followed issue, month by month, RDC's benchmarking process has consistently produced a wide variety of test results.

These varying results from similarly configured systems point toward one general conclusion: an inspection of hardware specifications alone could mislead a user into categorizing several systems as "basically the same" when in actuality each system may give distinctly different performance. Therefore there must be a further means of comparison, and RDC believes that this Benchmark Report series has filled that purpose.

As we have stated before and will continue to state, benchmark tests alone are not enough - but a user who does not include benchmarking as part of the decision process detracts significantly from his ability to base his judgment on the most complete information possible.

In the 12-issue summary to be published in December, you will have the opportunity to read the results of a year's work with small computer systems. It's rather amazing how side-by-side comparisons can serve to highlight the strengths and weaknesses of the systems tested. Be sure to prepare your own checklist of requirements . . . and be ready to be surprised, as we were, by some of the wide variations in small computer capabilities.

EXECUTIVE SUMMARY

In contrast to our previous experience with the Texas Instruments FS990/10, which was designed to address the scientific/engineering community, the DS990 Model 2 will be marketed for business applications in a commercial environment.

- In the RDC benchmarks, Model 2 showed strong results in the accounts receivable problem (C-3). However, the system could not load the scientific/engineering problem (C-1) because of memory limitations - the same limits experienced during the FS990/10 testing. When the size of this program was cut down (for the C-1A run), Model 2's memory could be loaded to produce run results.
- The memory limitations encountered during the benchmarks are the result of the high overhead taken by the TX5 operating system and BASIC. Since Model 2's absolute memory limit is 64K bytes, OEMs confirm that they must devise ways of overcoming "the squeeze" this limitation places on programming.
- Model 2 is positioned at the low end of the DS990 family. It is expected that much development work can be done on the larger systems (Models 4, 6 and 8) and then run in a production mode on Model 2 - the "workhorse" of the series.
- Compatible software support as offered by TI throughout the DS series merits special attention for anyone considering expansion or a new acquisition within a product line.
- Unfortunately, neither TI nor ACU could provide any names for the usual RDC survey of end users. Given the size and composition of the resulting Model 2 survey - interviews with only four technical users (three OEMs and one aspiring OEM), RDC was unable to elicit a wide range of comments on implementation and support services.

With the Model 2 in such an "infant" stage - in the hands of OEMs for only a few short months - most plans for this system have not been actualized. The OEMs interviewed had confidence in the system's future and in Texas Instruments, but there are more speculations than proven installations at this time.

BENCHMARK REPORT

SYSTEM: TI DS990 Model 2

PRICE AS TESTED: \$16,030

SPEED TESTS

Benchmark Number	CPU INTENSIVE	TOTAL TIME	
		Min.	Sec.
A-1	N = 500		43.5
A-2	N = 1000	1	25.9
A-3	N = 2000	2	51.0
A-4	N = 3000	4	16.3
A-5	N = 500		11.1
A-6	N = 1000		21.3
A-7	N = 2000		42.0
A-8	N = 3000	1	02.8
I/O INTENSIVE			
B-1	N = 500	1	23.0
B-2	N = 1000	1	41.3
B-3	N = 2000	2	15.9
B-4	N = 3000	2	47.7

"REAL LIFE" PROBLEMS

Benchmark Number		TOTAL TIME	
		Min.	Sec.
C-1	SCIENTIFIC/ENGINEERING	-	--
C-1A		5	59.7
C-2	NEW PRODUCT PLANNING		17.7
C-2A			37.5
C-3	ACCOUNTS RECEIVABLE	2	48.3
C-3A		3	22.4

EASE OF USE TEST

E-1	NUMBER OF KEYSTROKES REQUIRED	155
E-2	SUBJECTIVE JUDGMENT	Extremely Easy

THE BENCHMARK PROCESS

All benchmarks were run in the BASIC language on Texas Instrument's DS990 Model 2 - a packaged configuration which included the 990/5 microprocessor with 64K bytes memory, two diskette drives (double sided, double density), video display and keyboard, and 150 cps printer. Texas Instruments availed this configuration to RDC at its local Hamden, Connecticut office.

For the initial step, the benchmark programs were evaluated for compatibility of BASIC support. As with the Hewlett-Packard line tested last month, RDC was once again able to see how a manufacturer's claims of cross-compatibility actually translate into development savings for the end user. Following a diskette transcription by TI, the program listings used for the FS990 were usable on the DS990. A minor change was made in I/O statements to address the diskette drives through the proper channel.

TI's "TX BASIC" was found to be the same implementation as originally benchmarked in our April report. At that time RDC was working from a copy of "Preliminary Documentation" which has been revised and typeset in a new series of manuals but does not represent any significant language revisions. As noted previously, TI does support CALL statements for subroutine calls (Assembler subroutines may be CALLED). Structured programming (IF THEN ELSE syntax) is supported, but matrix handling with MAT statements is not. RDC has found that for its benchmarks (and for programming in general) matrix control statements are very useful.

After conversion to TX BASIC, the programs were entered and edited. Syntax diagnostics are not available during entry - only during execution.

In running the benchmark programs, once again TI's 64K memory was insufficient for some of the larger core runs. With the operating system and BASIC loaded into core, only 14,568 bytes remained for the benchmark programs. Although RDC is certain that the large programs can be accommodated with TI's FORTRAN IV or POWER BASIC, alternate test timings were not available for publication.

The programs which required modification in order to run were the CPU-intensive runs at the parameter 3000 (A-4 and A-8). These require an array of 3000, which

could be processed if the array was defined as integer data. The scientific-engineering problem (C-1) could not be run because of an array requirement. If this array was redefined as integer values, the results were found to be incorrect.

TI also offers a run-only mode of operation, which takes stored program files and executes them with no need to bring certain segments of the BASIC interpreter into core. For updating programs the user must select "Development Mode" which uses a version of BASIC requiring more core.

All jobs were run with results displayed on the screen (a default option) unless the run was a printer test. Changing from screen output to hard copy required the OPENing of the printer device and the assignment of a logical file number. The screen may be "frozen" (for examining a particular spot in the output) by pressing the command (CMD) key; execution is resumed by depressing the blank orange key.

After ensuring that the alterations necessary for running caused no changes in output expected, the programs were loaded into memory and the stopwatch was readied. The word RUN was keyed in, and the RETURN key and stopwatch were pressed simultaneously; when the results were displayed, the stopwatch was stopped and the run time recorded.

OVERVIEW OF PROGRAMS

The benchmark program set consisted of:

Speed Tests

- A CPU-intensive job of varying parameters
- An I/O-intensive job of varying parameters

'Real Life' Problems

- A scientific/engineering job
- A new product planning problem
- An accounts receivable generation, update and report

Ease of Use Test

- A script-based editing test

SPEED TESTS: CPU-Intensive and I/O-Intensive Jobs

Both the CPU-Intensive and the I/O-Intensive benchmarks were designed to test the speed of specific computing tasks that used repeated, short, individual operations.

CPU-INTENSIVE JOB

This short program executes a variety of calculations including addition, multiplication, division, square root and exponentiation. The program runs through an iterative process N times, with 'N' values of 500, 1000, 2000 and 3000.

A - 1	Results:	N = 500		43.5 seconds
A - 2		N = 1000	1 minute	25.9 seconds
A - 3		N = 2000	2 minutes	51.0 seconds
A - 4		N = 3000	4 minutes	16.3 seconds

Comment: Run A-4 could not be run "as-is" due to memory limitations. To execute the run, an array was defined to accept only integer values.

Variation: CPU-Intensive Alternate Runs (A5-A8)

This program performs the same number of calculations as the standard CPU-Intensive run but without exponentiation and square root.

A - 5	Results:	N = 500		11.1 seconds
A - 6		N = 1000		21.3 seconds
A - 7		N = 2000		42.0 seconds
A - 8		N = 3000	1 minute	2.8 seconds

Comment: Run A-8 was handled the same as A-4 in order to perform the run.

I/O-INTENSIVE JOB

This run stores numbers from 1 to N on disks and retrieves the first 50 of them in a factorial fashion (for example, for a total of 1275 reads following 3000 writes). Several combinations were run with 'N' values of 500, 1000, 2000 and 3000.

B - 1	Results:	N = 500	1 minute	23.0 seconds
B - 2		N = 1000	1 minute	41.3 seconds
B - 3		N = 2000	2 minutes	15.9 seconds
B - 4		N = 3000	2 minutes	47.7 seconds

Comment: Texas Instruments representatives mentioned that RDC's I/O benchmark utilizes sequential access, whereas TI had designed the TX5 operating system to favor random access. Although these I/O benchmarks do not show the DS990/2 to its best advantage, its times are still quite good in relation to other minis tested.

"REAL LIFE" PROBLEMS: Scientific/Engineering, New Product Planning, Accounts Receivable Generation

The next three benchmarks were designed to test the running time of actual programs that the user might want the computer to perform.

SCIENTIFIC/ENGINEERING

This problem solves a system of linear equations, using the Gauss-Jordan method of elimination. The program sets up the following system of 'N' equations with 'N' unknowns:

$$\begin{array}{rcl}
 0.1x_1 + 0.1x_2 + 0.1x_3 + \dots + 0.1x_N & = & 0.2 \\
 0.1x_1 + 0.3x_2 + 0.3x_3 + \dots + 0.3x_N & = & 0.4 \\
 0.1x_1 + 0.3x_2 + 0.5x_3 + \dots + 0.5x_N & = & 0.6 \\
 \cdot & & \cdot \\
 \cdot & & \cdot \\
 0.1x_1 + 0.3x_2 + 0.5x_3 + \dots + 9.9x_N & = & 10.0
 \end{array}$$

To show that the run has been executed successfully, the values of x_1 , x_2 , and x_N are printed at the end of the execution.

C - 1	Results:	* minutes	* seconds
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Comment: This problem could not be run due to limited memory. TI assures us that this run could be made using its FORTRAN IV or POWER BASIC

software products; however, in contrast to our April report on TI's FS990/10, alternate results were not made available.

Variation: C-1 Alternate Run (C-1A)

This program performs the C-1 run with a smaller number of equations and unknowns (35 equations/unknowns as compared to 50 in the larger run).

C - 1A	Results:	5 minutes	59.7 seconds
--------	----------	-----------	--------------

NEW PRODUCT PLANNING PROBLEM

This program models the relationship between product production costs and profitability over the range of the next four years. A base line is established, and several parameters are varied in a "what-if" mode on subsequent runs. Program output is printed in a standard report format of report line items across column years. The model's display line items are:

- | | |
|-----------------|--------------------|
| - Units Sold | - Distribution |
| - Selling Price | - Gross Profits |
| - Revenue | - Fixed Costs |
| - Raw Material | - Net Before Taxes |
| - Direct Labor | - Taxes Payable |
| - Packaging | - Net Income |

C - 2	Results:	17.7 seconds
-------	----------	--------------

Variation: C-2 Using Printer (C-2A)

This run reports the timing for the New Product Problem when results are routed to the printer for hard copy output.

C - 2A	Results:	37.5 seconds
--------	----------	--------------

ACCOUNTS RECEIVABLE GENERATION

In this job, an accounts receivable file of 50 records is created. Each record has 10 fields: customer number, salesman number, year-to-date sales, prior month sales (five fields), payments and credit limit. The file is updated randomly 10 times by customer number for sales amounts and payments. A report is displayed with billing detail, including company, salesman, year-to-date sales, credit limit, amount outstanding and sales by month.

C - 3

Results:

2 minutes

48.3 seconds

Variation:

C-3 Using Printer (C-3A)

This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

C - 3A

Results:

3 minutes

22.4 seconds

EASE OF USE TEST

The Ease of Use test is a script-based benchmark specifically designed to compare all editors with respect to ease of use. This comparison is accomplished by starting with a 9-line file, changing it to an interim form (in effect, editing in all the errors) and then changing the file back to its initial form. These changes test the editing capabilities when making the errors as well as when correcting them.

The editing tasks are:

- Line deletion
- Line insertion
- Line appendage
- Change/Addition/Deletion of unique words in a line/string
- Change/Addition/Deletion of non-unique words in a line/string

- Change/Addition/Deletion of unique characters (including spaces embedded in and not embedded in words) in a line/string
- Change/Addition/Deletion of non-unique characters (including spaces) in a line/string

E - 1

Results: Approximately 155 keystrokes were required to edit a nine record test file according to script.

Comment: *The editor is very easy to use and resulted in one of the lowest keystroke counts in our tests.*

TI DS990 Model 2: PRICING COMPONENTS

COSTS

The DS990 Model 2, as pictured on cover\$16,030*

Includes:

- DS990 Model 2 processor
- 911 VDT
- Two Model FD1000 Diskette Drives
- Model 810 Printer
- TX5 Operating System
- TX5 BASIC only - no Assembler language

* Subtract \$850 for "bare bones" system - no printer stand or cabinet

Components:

- DS990 Model 2 in cabinet
 - with 911 VDT \$14,300
 - with 820 KSR 15,300
- DS990 Model 2 in tabletop enclosure
 - with 911 VDT 13,700
 - with 820 KSR 14,700
- Model 810 Printer Master Kit, 990/5 2,380
- Model 820 KSR Master Kit, 990/5 2,480
- FD 1000 Single Drive 4,350
 - Secondary Kit 2,800
- FD 1000 Dual Drive 5,800
 - Secondary Kit 4,250

TI offers several schedules for quantity discounts.

OBSERVATIONS

Since the same catalog for the "990 Computer Family" was used to determine these prices, the same observation made for the FS990 held true. Written for technical people, the price list reads like a wholesale parts catalog and would be very confusing for end users.

USER COMMENTS

- The price/performance of the Model 2 has made me an avid user.
- The quality of equipment for price is great.

CENTRAL UNIT. . . . The 990/5 microcomputer may be housed in a workstation (single bay desk enclosure) or a cabinet.

CPU Memory: 64K bytes

Keyboard: Alphanumeric - 128 full ASCII
10 programmable function keys
10-key calculator pad

Screen: Model 911 Video Display Terminal

- 1920 characters in 80 x 24 display
- or
- 960 characters in 80 x 12 display
- 96 character ASCII, upper and lower case
- 12" diagonal
- Programmable levels of intensity
- Optional graphic drawing set

OBSERVATIONS

RDC tests show that the TX5 operating system and BASIC take up so much memory in the Model 2 that the large scientific/engineering problem could not be loaded. This same condition was identified in the earlier report on the FS990/10.

USER COMMENTS

- *I have some programming problems because of the high system overhead.*
- *The multi-user ("run only") mode allows more memory than single-user ("development") mode.*

TI DS990 Model 2: HARDWARE COMPONENTS

STORAGE

The DS990 Model 2 features FD1000 double-sided, double-density flexible disk drives. Each drive stores 1.15M bytes of formatted data. Model 2 can accommodate a total of four drives to provide a maximum of 4.6M bytes.

Detail on Diskettes

- The double-sided, double-density diskette is formatted in 288-byte sectors, 26 sectors per track, 77 tracks per diskette and two tracks per cylinder.

Hard Disk Option

- Hard disk capability may be provided by adding a DS10 Disk Drive (9.4M bytes - 4.7 fixed, 4.7 removable).

Other: Reel-to-Reel magnetic tape (800/1600 bpi)

OBSERVATIONS

RDC's I/O-intensive runs use the sequential access method and do not show the true capability of the FD1000 drives, which are designed to use random access concurrently on both sides of the diskette.

USER COMMENTS

- *The hard disk capability is a definite selling point.*
- *The FD1000 gives four times the storage capacity of the previous diskette drives (FD800s).*

OTHER DEVICES

- Printers:
- Impact Printer (132 columns)
 - Model 810 - 150 cps, 60 lpm
 - Line Printers (132 columns)
 - Model 2230 - 300 lpm
 - Model 2260 - 600 lpm
 - Thermal Printers (80 columns)
 - Model 743 KSR Data Terminal - 30 cps
 - Model 733 ASR Data Terminal - 1200 baud (full duplex)

- Options:
- 911 VDT - Video Display Terminal
 - 820 KSR Terminal - 150 cps

- Communications:
- Synchronous
 - Asynchronous
- } Baud rates of 75, 110, 150, 200
300, 1200, 2400, 4800, 9600
- Both parallel and serial interfaces

OBSERVATIONS

All four OEMs interviewed intend to use dual 911 VDTs on their systems.
The Model 810 printer seems to be standard for most configurations.

USER COMMENT

- *Due to the brevity of the user survey, there were no pertinent comments on these components.*

TI DS990 Model 2: SOFTWARE COMPONENTS

OPERATING SYSTEM, LANGUAGES & UTILITIES

Operating System: TX5

Languages: Choice of BASIC, FORTRAN IV, Pascal and 990 Assembly
Newly announced - DX5 Run-time COBOL

Access Methods: Sequential, random

Utilities: The TX5* operating system includes all of the components of the TXDS operating system - Two-Pass Assembler, Text Editor, Linker, Cross-Reference, Copy/Concatenate, PROM Programmer, BNPF High/Low Dump, IBM Diskette Conversion, System Generation, Diskette Backup, Object Manager, LIST 80-80 and Diskette Dump.

In addition, TX5 supports DX10 compatible, sequential and relative record file management; plus a screen-oriented text editor.

*This package falls into TI's "Category A" software (license purchased on a one-time only basis). TX5 is included as part of the standard Model 2 configuration; it is priced separately at \$1,700.

OBSERVATIONS

With the operating system and BASIC loaded into core, only 14,568 bytes remained for the RDC programs. This amount of memory was insufficient to load the scientific/engineering (C-1) program.

USER COMMENTS

- Most programmers will use a little Assembler along with BASIC for efficiency.
- The flexible language offerings and compatibility between systems are really "plus" factors.

TI-SUPPLIED PACKAGES

General

The 990 software is classified in three categories;

- Category A - Software License* - purchased once, no additional charge; no sub-licensing.
- Category B - Software License* - licensed per CPU, must be purchased once for each CPU on which software will reside; sub-licensing also charged.
- Unlicensed Software - no licensing restrictions; no subscription service, but updates may be purchased.

* Licensed software includes a subscription service which provides software updates for one year following purchase (and which may be renewed after the initial year).

Specific for the 990 Computers (Selected)

- TX5 - Operating system
- TX FORTRAN IV License
- TX BASIC License
- TX3780 - Emulator License
- 990 Diagnostic Kit

OBSERVATIONS

TI is definitely not in the software applications business. The software offered for the 990 computer family comprises the operating system, utilities programs and some specialized software for applications development.

Users themselves bridge the software gap through the TI-MIX Users Group which meets yearly at a conference to share ideas for utility programs. Also, the TI-MIXER newsletter is published bi-monthly to supply users with new developments and current articles from the field.

USER COMMENTS

- *I like the fact that the Model 2 software is compatible with the larger DS systems.*
- *TI's software testing group is on top the the bugs.*

EDITOR

The TI editor is line oriented and uses a "window" as a cursor. Editing is primarily controlled by means of a group of keys on the left-hand side of the keyboard.

OBSERVATIONS

Editing is accomplished in the following manner:

- Keying in a line number and pressing the up or down arrow key will display the line with the cursor positioned at the first character of the statement.
- Modifying the statement for the desired result is performed by using the other edit keys - left/right arrow, insert character (INS CHAR), delete character (DEL CHAR), REPEAT, erase field and erase input.

In addition, a blank gray key can recall the last command entered; a TAB SKIP key can append information to a line; and a FIELD skip key can skip over eight characters at a time.

TI does supply a software editor for more powerful editing on larger DS990 systems.

USER COMMENT

From the RDC analyst . . .

- *The editor is quite straightforward and very efficient. The ease of use test resulted in one of the lowest keystrokes in this series.*

DOCUMENTATION

TI offers one or more of three types of manuals for each of its hardware products:

- Installation and operation - start-up "how to" instructions
- Field maintenance - preventative procedures and trouble-shooting techniques
- Depot maintenance - diagnosis at the circuit level

Manuals available for the programmer:

- BASIC Programmer's Guide
- TX BASIC Reference Manual

TRAINING

The Education and Development Center of TI's Digital Systems Division offers regularly scheduled courses in both software implementation and hardware maintenance. Self-study is also available through audio cassettes.

MAINTENANCE

TI offers three levels of Maintenance Agreement Coverage - Basic, Extended and Full Service - as well as On Call Service. The itemized price list quotes only the Basic rate, which covers equipment from 8 a.m. to 5 p.m. Monday through Friday (excluding holidays).

For those customers who prefer the do-it-yourself approach, Fixed Price Repair Service can be performed on components shipped to the factory. (Customers must stock their own spare parts.)

USER COMMENTS

- *They have good engineers in the field - I have no grief with any work done.*
- *Information in the manuals is relatively clear but scattered.*
- *Documentation has improved 200% in the last three years.*

SUMMARY OF USER COMMENTS

Actually, it's hard to characterize this as a "user summary" - there really are no "end users" in it and the "summary" is based on a grand (?) total of four interviews! Because the Model 2 is such a newly released product, it has not yet penetrated the end user market at this time. So our survey was limited to technical users (three OEMs and one aspiring OEM) who were using TI's Model 2 to develop applications software.

All four respondents were creating business applications - general accounting packages for CPAs and veterinarians, systems for telephone control and small manufacturing operations, and scheduling systems for radio broadcasting. They were employing BASIC, with FORTRAN and Assembler for sub-routines and SORTs.

These users have confidence that Model 2 is capable and competitive with other systems. The would-be OEM said that he had not encountered any other system with a hard disk option which delivered the same quality of equipment for the price. An OEM agreed that the possibility of upgrading to hard disk was a "definite selling point" for his customers. Seven years an OEM, this same man said that the price/performance of TI's products had made him "an avid user."

All interviewees mentioned that the absolute memory limit of 64K bytes creates programming problems. "The Model 2 has one drawback - it uses lots of memory." One OEM characterized the TX5 operating system as "a little greedy on memory"; he noted that he was employing the ASSIGN USING command to make greater use of the disk to overcome the memory limitations. "I've gotten used to writing small programs," replied one user, and added that he's gone to partitioning programs to get around space problems. Another OEM observed that the multi-user mode allows more memory than the single-user mode.

Plus factors cited by all three users included Model 2's "plug-easy" installation, the reliability of the hardware, having the software compatible with the larger DS systems, the flexible language offerings . . . and, of course, the price.

During this particular survey, comments on support services were skimpy. An experienced OEM remarked that documentation "has improved 200% in the last three years." He added that he can usually find any missing answers over the hotline. A new TI user was impressed by the "volumes and volumes" of documents - a full six binders "plus" - and the timely releases on software bugs from the software testing group. In general, these users liked working with TI - "they're good engineers" - and concurred that their only complaint was the company's lag in shipping new products.

CONCLUSIONS

For a number of reasons it is hard to come to "conclusions" about the DS990 Model 2 at this time. The system has so recently been introduced to the marketplace that even OEMs can only talk in "futures." Months ago, when ACU first made arrangements to benchmark Model 2, Texas Instruments expected the system to be installed in many locations by Fall '79. But Model 2 experienced some slippage in delivery schedules - a not uncommon happening in this industry - and as a result our "conclusions" must be less than conclusive!

As described by TI headquarters and OEMs alike, Model 2 is a "target system" - marketed with a reasonable price tag to allow small end users "painless entry" into the DS990 family of computers. On the low end of the 990 series, it affords users a limited multi-user capability, and compatible software for easy upgrades.

In the RDC benchmarks, Model 2 made a very strong showing in the accounts receivable problem (C-3). However, the benchmark tests reveal one deficiency in the Model 2: its operating system and BASIC software consume a considerable amount of memory. This systems software overhead is so heavy that the scientific/engineering program (C-1) could not be loaded to run. Users with large programs should be aware of this shortcoming when they are estimating their memory requirements.

Although RDC views Model 2's memory limitation of 64K as a possible drawback for users, TI points out that a simple "conversion kit" can transform the system into a Model 4 with 128K of memory. Another way around the memory limitation is to use larger members of the 990 family for program development (which requires more memory), and then run these programs in a production mode (which requires less memory) on the compatible Model 2. However, neither of these points solves the problem of memory limitation if the Model 2 is viewed as a stand-alone system.

Unfortunately, this issue lacks the well-rounded perspective usually achieved in other Benchmark Reports by including comments from experienced end users. Without such pertinent information describing proven applications and installations, potential buyers are left with two options: reliance on prior experience with Texas Instruments - the company and its products; or a wait-and-see attitude until all the votes can be counted on Model 2.

NEXT ISSUE: 12 Issue Summary

BENCHMARK REPORT

Vol. 1, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members \$150/year, non-members \$190/year. Overseas subscribers add \$30 for airmail postage.

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ASSOCIATION OF COMPUTER USERS

P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 499-1722

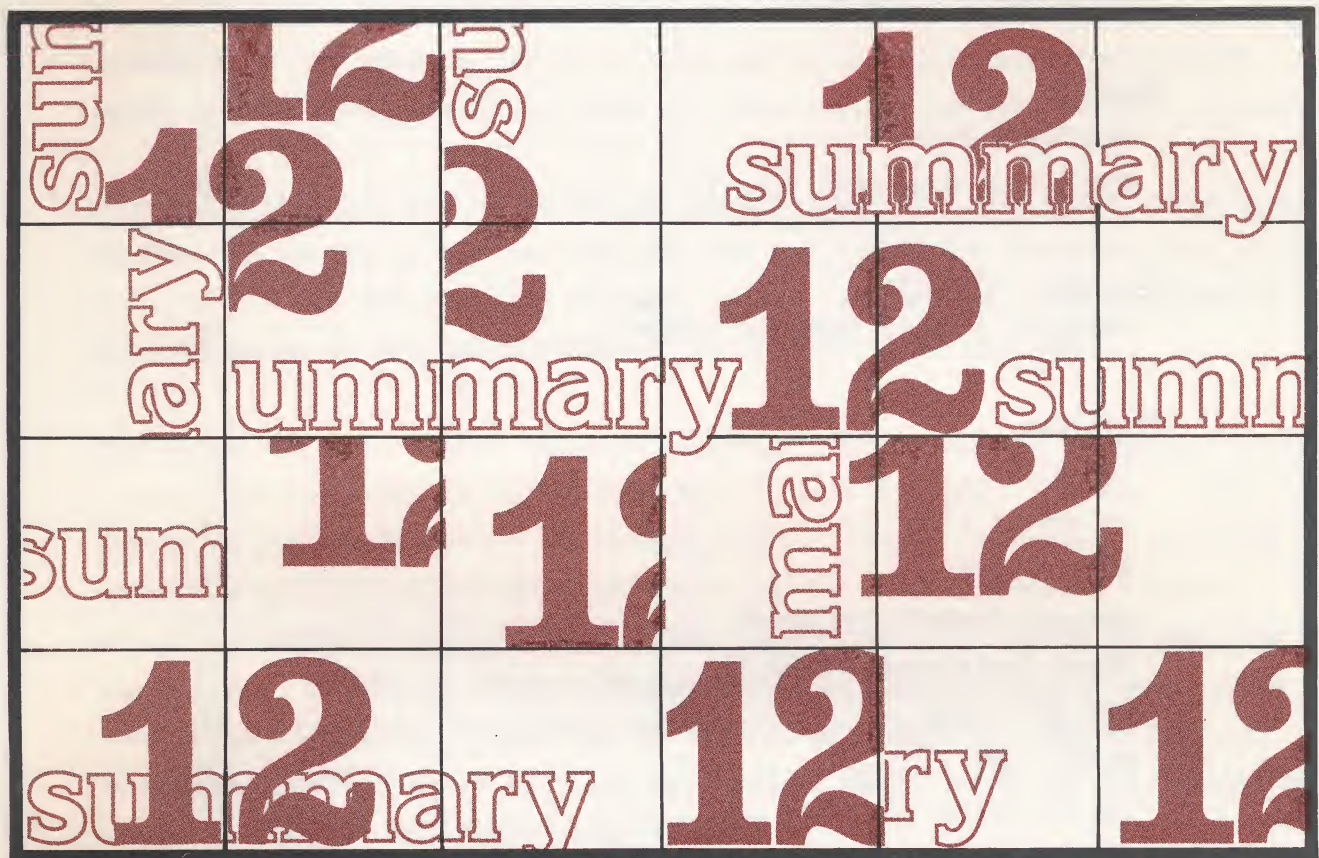
REAL DECISIONS CORPORATION

111 High Ridge Road
Stamford, Connecticut 06905
Tel. (203) 329-2071

BENCHMARK REPORT

ASSOCIATION OF
COMPUTER USERS

VOLUME 1, NUMBER 14, DECEMBER 1979



12 Issue Summary

- **IBM 5110**
- **DATAPOINT 1170**
- **WANG 2200VP**
- **RANDAL RDS-100**
- **Q1 LITE Microcomputer System**
- **HEWLETT PACKARD 250**
- **HEWLETT PACKARD System 45**
- **TEXAS INSTRUMENTS FS990/10**
- **DEC PDP 11V03**
- **SPERRY UNIVAC BC/7 Model 610**
- **NORTHERN TELECOM/SYCOR 405**
- **TEXAS INSTRUMENTS DS990 Model 2**

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1 2 I S S U E
S U M M A R Y R E P O R T

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PREFACE

Here it is: the results of a year's work in evaluating small computer systems. The twelve systems involved in this summary report have all been individually treated in the same manner by Real Decisions Corporation (RDC): tested by a standard set of benchmark runs to yield comparative results; surveyed in the field to gather a cross-section of subjective comments from experienced users; and analyzed for offerings in hardware, software, services and price. Now this final Benchmark Report issue presents a side-by-side compilation of all these results in summary form.

At the beginning of this report is the Executive Summary, which offers a brief summation of the systems tested in this series and also characterizes the range of benchmark results for each - from excellent to good to fair to poor.

A detailed presentation of benchmark results comprises four pages - two pages to cover tests run on all the systems, and two additional pages to give alternate results for the last six systems. These side-by-side results reveal a wide variation in the performance of the participating systems.

The center section of this issue is introduced by "decisions triangles" which present the key elements to consider when choosing a small computer. Each system is then described by a one-page "profile" which includes: benchmark standings in relation to the other eleven systems, best features offered, possible drawbacks, and any update information (new announcements) supplied by the vendor. Of course, these profiles merely hit the extreme points - both good and bad - for the systems in these Benchmark Reports. For a full and comprehensive analysis of each system, readers should refer to the individual issues written monthly during this series.

Finally, the concluding pages elaborate on the decision process outlined in the triangles by interweaving related examples from systems studied in this series. Since each user's choice must be tailored to his specific requirements, these "conclusions" take the form of guidelines to follow in making any buying decision.

EXECUTIVE SUMMARY

In this summary, RDC's team of analysts offers a thumb-nail sketch of each small computer tested in this series during the past year.

The benchmark results listed with each system are based on the following placement scale:

1	2	3	4	5	6	7	8	9	10	11	12
excellent			good			fair			poor		

quartile = 1st 2nd 3rd 4th

- IBM 5110 - Good to fair benchmark results.

The 5110 offers users a low-risk and dependable stand-alone system for basic business needs. IBM's reputation for good service and customer support also provides a corporate comfort factor for buyers. With the price cut announced in the spring of 1979, IBM offers this system at a cost below the median for those tested in this series. Outstanding features include a hardwired APL language and double-sided, double-density disks. Negative factors cited are the CRT's column limit of 64 characters and poor readability of display.

- DATAPoint 1170 - Good to poor benchmark results.

If you want to take a flexible, mix-and-match approach in building a computer facility, Datapoint's family of small computers may be the right choice. Characterized by users as an "extremely friendly" system, the hardware is plug-compatible and easy to upgrade. Datapoint also supplies extensive software support - however, this emphasis on software implementation tends to minimize the memory available for the user's programs.

- WANG 2200VP - Excellent to fair benchmark results.

The 2200VP is an excellent computer for the user who has a heavy requirement for handling large, complex calculations with speed and precision. These superior number-crunching abilities netted Wang three "firsts" in the rankings. Especially appreciated by technical users was Wang's emphasis on machine control, almost at the systems programming level. However, end users may find it necessary to have customized software written to deal with Wang's method of file handling, which prevented performance of I/O-Intensive runs B-3 and B-4.

- HEWLETT-PACKARD SYSTEM 45 - Excellent to fair benchmark results.

The most compact and portable unit tested, System 45 provides some powerful hardwired capabilities, including a highly enhanced BASIC language, extensive CRT graphics and a built-in thermal printer. The system can be upgraded easily with plug-in ROMs, and users from the scientific community report overall high performance and reliability. Against all these advantages the prospective buyer will have to weigh the 45's relatively high price.

- TEXAS INSTRUMENTS FS990/10 - Excellent to fair benchmark results.

The FS990/10 is strong and dependable hardware, packaged in modular components for OEMs who then use it as a development tool to design applications software. End users should be aware that they will be dependent on their local OEM for a complete hardware/software package and also for service and support. One drawback revealed during the RDC tests was that the BASIC language and operating system occupy such a large portion of memory space that the scientific/engineering problem (C-1) could not be loaded to run.

- DEC PDP-11V03 - Excellent to poor benchmark results.

Wearing the lowest price tag of the systems reviewed in this series, this smallest member of the DEC PDP-11 "family of products" offers a lot of reliable hardware for the money. Since this hardware is delivered to Digital OEMs, who add the applications software required, end users are cautioned to check out the local OEM as carefully as the DEC product itself. Digital's extensive line of peripherals enhances the 11V03, but one negative factor is the absolute memory limit of 64K.

- RANDAL 100 - Good to poor benchmark results.

The RANDAL 100 is a complete hardware/software package marketed to users who want a turnkey system for general business needs. Since most users in the RDC survey had converted directly from a manual system, the RANDAL 100 seemed speedy to them - even though RDC tests revealed the 100 to be medium to slow. Since distributors supply the critical interface, satisfaction/dissatisfaction related directly to the relationship between the local supplier and the customer.

- SPERRY-UNIVAC BC/7-610 - Good to poor benchmark results.

The highest priced system tested in the series, the BC/7-610 is offered by Sperry-Univac as a comprehensive hardware-software-service package for smaller businesses. Instead of BASIC the BC/7-610 supports a compiled version of RPG II - not a widely-used language on this class of system; for end users Sperry-Univac has available its own proprietary ESCORT programming language. Flexible software offerings and reliable service were two outstanding features reported by users. On a price/performance basis, however, the BC/7-610 did not fare well during the RDC tests.

- Q1 LITE - Good to poor benchmark results.

Q1 Corporation has designed this small computer to satisfy both word processing and data processing needs. A compact and easy to operate system, approachable even by a novice, the Q1 Lite was purchased most often for applications software - especially for its credit union package, rated excellent by users. Good points include a compiled PL/1 language for program development and personalized attention from the Q1 Corporation. Other factors to note are the differences in the screen - only 40 columns wide with a plasma display - and field service which generally centers around the N. Y. metro area plus Federal installations.

- NTSC 405 - Fair to poor benchmark results.

A low-priced entry in this series, the 405 is currently marketed by a company "in transition" (from Sycor to NTSC). As a stand-alone system, the 405 seemed to be competing out of its league - it could not perform three of nine runs, and it gave disappointing results overall. Viewed as an intelligent terminal during the RDC survey, the 405 received good marks for data collection and on-site input. A wide range of communications options is available to accommodate distributed networks. Otherwise, NTSC offers few hardware options and no direct support for applications software.

- HEWLETT PACKARD 250 - Excellent to good benchmark results.

The HP 250 manages to delight both programmers and operators - and even onlookers! Designed as an attractive desk-console unit with "human engineering" for ease of operation, the 250 also offers users excellent programming tools. For the operator outstanding features include the CRT unit, which is swivel-mounted for adjustable viewing and equipped with "softkeys" for guided execution of programs. For the programmer HP supplies hardwired features such as an enhanced BASIC language and a powerful operating system. Reliable hardware, easy to upgrade, is complemented by applications software for business needs. Price may be the only deterrent.

- TEXAS INSTRUMENTS DS990 MODEL 2 - Excellent to fair benchmark results.

Targeted for the business community, Model 2 is marketed through OEMs who supply the applications software required by end users. Software compatibility throughout the 990 series is a definite "plus" for upgrades or expansions within the family. As with TI's FS990/10, RDC's benchmarks revealed that the amount of memory taken up by BASIC and the operating system prevented running of the scientific/engineering (C-1) problem. The absolute memory limitation of 64K bytes presents some program development problems. Plans call for Model 2 to run in production modes which require less memory; however, RDC could not gather any commentary from end users to verify these expectations because Model 2 is such a newly-released product.

THE BENCHMARK PROCESS

The set of benchmark results on the following two pages is the heart of this series of reports. It is important to review the RDC benchmarking process to understand just how these timings were obtained.

As a base line, each system tested was chosen to fit within the hardware specifications of this series: 64K memory or less, dual diskette drives for storage, a CRT/keyboard unit for input and display, and a printer for hard copy output. In addition, the configuration's price was held within the \$15,000 to \$25,000 range. Initially, orientation toward a single-user system was preferred, as was the BASIC language. Later, as the series developed, some systems with multi-user options were included; also, in some cases systems used other languages (RPG II and PL/I).

For each system the steps of the RDC benchmark process followed this sequence: evaluation of the system's BASIC for compatibility of support, or conversion to the alternate language; RDC programs entered and debugged; RDC programs executed and timed with a stopwatch; opportunity provided for vendor to submit alternate results (in another language or reprogramming in BASIC to feature particular capabilities); verification of vendor's alternate results.

The table of programs run for all systems includes:

PROGRAM	DESCRIPTION
CPU-INTENSIVE A-1 - A-4	Executes a variety of calculations including addition, multiplication, division, square root and exponentiation; runs through an iterative process N times, with 'N' values of 500, 1000, 2000 and 3000.
I/O-INTENSIVE B-1 - B-4	Stores numbers from 1 to N on disks and retrieves the first 50 of them in factorial fashion; run with 'N' values of 500, 1000, 2000 and 3000.
SCIENTIFIC/ ENGINEERING C-1	Solves a system of linear equations (50 equations in 50 unknowns) using the Gauss-Jordan method of elimination.
NEW PRODUCT PLANNING C-2	Calculates the relationship of production costs and profitability over a four-year period and produces a formatted report displaying results.
ACCOUNTS REC. GENERATION C-3	Creates a file of 50 records, each with 10 fields; updates file randomly 10 times by customer number for sales amounts and payments; prints report with billing detail.
EASE OF USE TEST E-1	Changes a 9-line file using a variety of editing tasks.

For the second set of six systems three additional runs were made. These are treated separately on pages 10 and 11.

BENCHMARK SUMMARY

	IBM 5110	DATAPoint 1170	WANG 2200VP	HP SYSTEM 45	TI FS990/10	DEC PDP-11V03
	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec
<u>CPU INTENSIVE</u>						
A-1 N = 500	21.8	1:19.2	2.5	4.6	42.5	14.2
A-2 N = 1000	42.2	2:36.5	5.0	8.7	1:25	27.5
A-3 N = 2000	1:23.4	5:05.7	9.6	17.0	2:49	53.7
A-4 N = 3000	2:04.7	7:33.0	14.2	25.2	4:12.2	1:20.3
<u>I/O INTENSIVE</u>						
B-1 N = 500	2:31.4	1:23.0	1:45.4	33.0	1:08.3	37.1
B-2 N = 1000	2:59.6	1:40.3	2:10.7	37.8	1:27.3	45.9
B-3 N = 2000	3:47.4	2:14.7	-- ¹	53.1	1:52.5	1:08.7
B-4 N = 3000	4:38.4	2:47.5	-- ¹	1:06.3	2:17.3	1:29.1
<u>REAL LIFE PROBLEMS</u>						
C-1 Sci./Eng.	29:47.2	38:27.5	2:05.8	4:38.9	-- ²	14:43.4
C-2 New Prod.	24.2	17.3	1.2	9.3	23.2	45.8
C-3 Acc./Rec.	4:11.0	6:50.4	3:20.0	5:05.8	3:18.6	4:14.0
EASE OF USE	200	170	165	183	157	200

¹These programs could not be run as-is with parameters of 2000 or more because each write resulted in a whole sector being written, and the data file was larger than the boundaries of the disk.

²This program could not be loaded due to memory limitations.

NOTE: FOR A FULL EXPLANATION OF THESE BENCHMARK RESULTS, REFER TO THE INDIVIDUAL ISSUES ON EACH OF THE SYSTEMS.

BENCHMARK SUMMARY

RANDAL 100	SPERRY UNIVAC BC/7-610	Q1 LITE	NTSC 405	HP 250	TI DS990 Model 2	
RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	
1:17.8	2:22.5	1:26.1	8:29.0	4.1	43.5	<u>CPU INTENSIVE</u>
2:31.4	2:36.3	2:37.9	14:57.8	7.8	1:25.9	A-1 N = 500
4:57.1	3:04.2	5:02.7	27:53.3	14.9	2:51.0	A-2 N = 1000
7:22.8	3:33.2	7:27.3	-- ³	22.3	4:16.3	A-3 N = 2000
						A-4 N = 3000
						<u>I/O INTENSIVE</u>
2:39.0	5:59.0	1:43.8	4:32.2	24.8	1:23.0	B-1 N = 500
2:46.0	6:05.0	2:20.6	5:01.8	28.0	1:41.3	B-2 N = 1000
2:59.2	6:17.7	3:28.9	6:01.2	34.5	2:15.9	B-3 N = 2000
3:12.2	6:29.8	4:38.4	6:59.9	40.8	2:47.7	B-4 N = 3000
						<u>REAL LIFE PROBLEMS</u>
13:52.4	12:09.2	6:50.7	-- ³	4:05.9	-- ³	C-1 Sci./Eng.
32.0	3:42.2	18.7	-- ⁴	10.3	17.7	C-2 New Prod.
10:05.0	10:37.0	5:03.3	-- ⁴	4:45.7	2:48.3	C-3 Acc./Rec.
248	208	175	195	152	155	EASE OF USE

³This program could not be run due to insufficient memory.

⁴Printout to the screen could not be formatted. For alternate runs using the printer (Runs C-2A and C-3A) refer to page 11.

NOTE: FOR A FULL EXPLANATION OF THESE BENCHMARK RESULTS, REFER TO THE INDIVIDUAL ISSUES ON EACH OF THE SYSTEMS.

ADDITIONAL BENCHMARK RESULTS FOR LAST SIX SYSTEMS

As requested by ACU, RDC introduced some variations to the initial set of benchmark programs in the June report on our seventh system, the Randal 100. These additional runs continued through the last six systems in the series. A description of these run variations and their results are covered in this two-page section.

CPU-INTENSIVE ALTERNATE RUNS A-5 TO A-8

This program performs the same number of arithmetic calculations as the standard CPU-Intensive runs (A-1 through A-4) but excludes square root and exponentiation. Differences in relative results between the two sets of CPU runs is therefore directly related to a minicomputer's performance of these higher functions.

COMMENTARY ON RESULTS

In this smaller version of the CPU-Intensive problem, HP's 250 emerged as "number 1" overall. Note that TI's DS990 Model 2 started out in A-5 as second to HP, but by A-6 Q1 Lite has taken over second place and retains that standing through A-8. The NTSC 405 dropped out at the 3000 parameter due to insufficient memory.

SCIENTIFIC/ENGINEERING ALTERNATE RUN C-1A

This program performs the C-1 run with 35 equations/unknowns as compared to 50 in the standard run.

COMMENTARY ON RESULTS

When the equations/unknowns were cut back to 35, HP's 250 took first place followed by Q1 Lite in second and Randal 100 in third. In contrast to C-1 results, note that TI's DS990 Model 2 had sufficient memory to load this problem and came in fourth in the standings.

NEW PRODUCT PLANNING PROBLEM USING PRINTER C-2A

This run reports the timing for the new product problem when results are routed to the printer for hard copy output.

COMMENTARY ON RESULTS

In this variation of the C-2 problem, the first two placements remained the same - HP's 250 retained first place and TI's DS990 Model 2 retained second. Showing the influence of its 125 lpm printer, the Randal 100 system moved up to third place, while Q1 Lite's 45 cps printer slowed its results to fourth position. By routing output to printer, NTSC's 405 could also participate in this run, but with last place results.

ADDITIONAL BENCHMARK RESULTS
FOR LAST SIX SYSTEMS

RANDAL 100	SPERRY UNIVAC BC/7-610	Q1 LITE	NTSC 405	HP 250	TI DS990 Model 2	
RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	RESULTS Min:Sec	
14.6	2:11.7	14.7	2:57.0	3.4	11.1	<u>CPU INTENSIVE</u>
35.0	2:15.9	20.0	3:52.1	6.3	21.3	A-5 N = 500
1:07.2	2:24.3	30.8	5:43.9	12.3	42.0	A-6 N = 1000
1:38.5	2:32.6	41.5	-- ¹	18.2	1:02.8	A-7 N = 2000
						A-8 N = 3000
						<u>REAL LIFE PROBLEMS</u>
4:56.9	8:16.8	2:43.8	22:33.0	1:28.5	5:59.7	C-1A Sci./Eng.
46.8	3:38.9	1:34.8	3:51.9	34.7	37.5	C-2A New Prod.
10:29.3	10:46.7	7:13.3	19:25.9	5:19.8	3:22.4	C-3A Acc./Rec.
¹ The program could not be run at this parameter due to insufficient memory.						

ACCOUNTS RECEIVABLE PROBLEM USING PRINTER C-3A

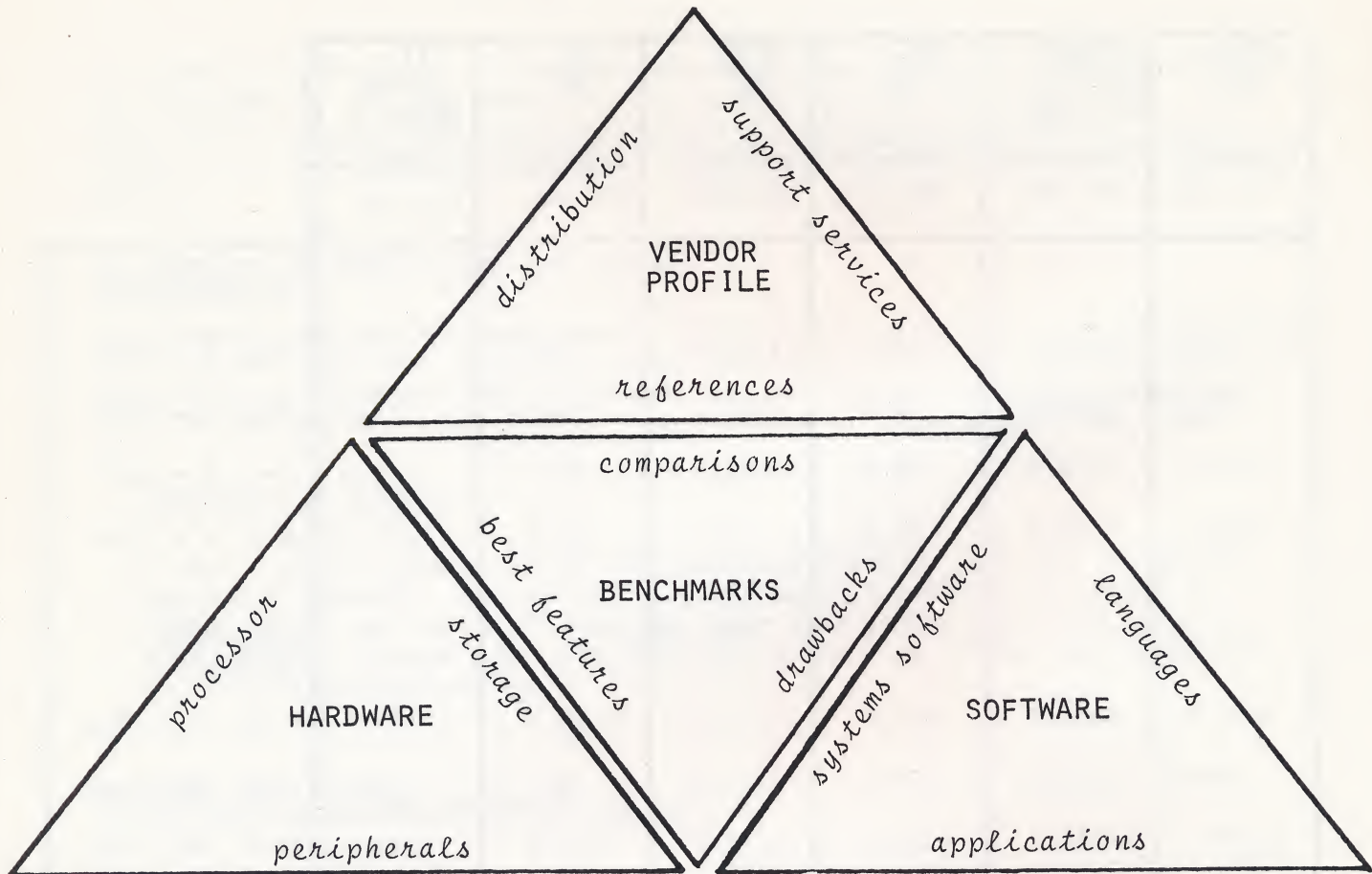
This run reports the timing for the accounts receivable problem when results are routed to the printer for hard copy output.

COMMENTARY ON RESULTS

NTSC's 405 could perform this run, but since it took last place, the standings from C-3 remained the same: TI's DS990 Model 2 took first place and the HP 250 was second; Q1 Lite, the Randal 100 and Sperry Univac BC/7-610 followed in sequence.

NOTE: FOR A FULL EXPLANATION OF THESE ADDITIONAL BENCHMARK RESULTS, REFER TO THE INDIVIDUAL ISSUES ON EACH OF THESE LAST SIX SYSTEMS.

DECISION TRIANGLES



CHOOSING A SMALL COMPUTER SYSTEM

The RDC decision triangles display the key elements to consider when you are choosing a small computer system. The triangles call for:

- a review of the vendor - his style of business and his reputation.
- an assessment of the product itself - both hardware and software components.
- benchmark tests - designed to elicit the good and bad points of a system, and to form the basis of comparisons between systems.

Prior to launching the in-depth assessment suggested by the decision triangles, it is absolutely essential to conduct a thorough and complete review of your own needs in order to establish those criteria which are important to you. The self-knowledge gained by such an assessment will enable you to resist a good sales pitch and allow you to concentrate on deciding whether or not a vendor's system provides the right "match" for your individual requirements.

VENDOR PROFILE + HARDWARE + SOFTWARE + BENCHMARKS = TOTAL PRICE/PERFORMANCE

VENDOR PROFILE

- Investigate the method of product DISTRIBUTION used: centrally controlled or via OEMs/distributor networks.
- Evaluate the quality of SUPPORT SERVICES - documentation, field repairs and training.
- Take time to check REFERENCES from customers who have needs similar to yours.

HARDWARE

- Check the speed and precision of the central PROCESSOR unit, as well as memory provided for your programs.
- Evaluate the types and amounts of STORAGE capacity available and methods of file handling used.
- Investigate other PERIPHERALS: CRTs/keyboards, printers and communications facilities.

SOFTWARE

- Assess ease of use and efficiency of SYSTEMS SOFTWARE - the operating system, utilities and editor.
- Evaluate the system's LANGUAGE - the choices available and the level of implementation.
- Ascertain if the APPLICATIONS packages fit the needs of your business.

BENCHMARKS

- Perform tests to determine the strengths of a system - its BEST FEATURES.
- Perform tests to determine the weaknesses of a system - its DRAWBACKS.
- Make COMPARISONS on the basis of these tests between small systems in the same price/configuration category.

PROFILE: IBM 5110

Price as tested = \$19,975*

BENCHMARK STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2					✓							
I/O	B-2									✓			
SCI/ENG	C-1								✓				
NEW PROD	C-2								✓				
ACC REC	C-3				✓								
EDIT	E-1									✓			
		Excellent			Good			Fair			Poor		

COMMENT:

The 5110's best showing was fourth place in the accounts receivable problem, with a fifth in the CPU-intensive runs. Other results dropped down to the third quartile, with the weakest outcome in the I/O-intensive runs.

BEST FEATURES....

When this report series was begun in the fall of 1978, IBM had the jump on diskette technology and was the only one then offering double-density, double-sided disks. Users consistently named the diskettes as the 5110's "best feature," especially when compared to the previous cartridge storage of the 5100.

Of the twelve systems in this summary, only the 5110 offered the APL language as a hardwired option. This was an important consideration for half of the IBM users surveyed.

DRAWBACKS.....

Of all the systems tested, only the 5110 and Q1 Lite had a CRT screen smaller than 80 columns wide. IBM users considered the 64-character screen to be a frustrating limitation in both programming and debugging. In addition, users rated the screen's readability as poor.

*UPDATE:

Price reductions announced in the spring of 1979 would cut this configuration's cost to \$16,435.

NOTE:

The 5110 issue reflected an impression gained from the user survey - that IBM's offering of the APL language was "unique." Following the publication of the 5110 report, Interactive Computer Systems, Inc. (ICS) took exception to this RDC comment. ICS, a distributor for MCM computers in the U.S., pointed out that MCM's System 700 (introduced in 1974) was the first small computer to offer APL.

PROFILE: DATAPoint 1170

Price as tested = \$20,330*

BENCHMARK STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2										✓		
I/O	B-2					✓							
SCI/ENG	C-1									✓			
NEW PROD	C-2				✓								
ACC REC	C-3									✓			
EDIT	E-1					✓							
		Excellent			Good			Fair			Poor		

COMMENT:

Since many high-level math functions are software-implemented rather than hardwired, the 1170 failed to compete well in the benchmarks requiring heavy calculations: the CPU-intensive results are in the fourth quartile, while the scientific/engineering and the accounts receivable problem just make it into the third quartile. The 1170's best showing was second-quartile placement in the new product and I/O-intensive runs.

BEST FEATURES...

Datapoint has made a great effort to design its whole family of products for flexibility and compatibility of usage. This philosophy enables a user to be assured that his initial purchase may be upgraded with plug-compatible components. Emphasis on compatibility also extends to Datapoint's extensive software offerings. Generally, 1170 users were people who enjoyed this flexible mix-and-match approach.

DRAWBACKS.....

Datapoint's decision to emphasize flexible software usage detracts from its equipment's ability to match the performance of hardwired units. Implementation of capabilities through software also quickly fills up memory capacity, so users should be aware that they may have to purchase more memory initially to provide the workspace needed.

*UPDATE:

The 1170 series tested by RDC has been phased out. Datapoint informs us that the 1802 small computer system would now be its "sensible replacement." The 1802 configuration is priced at an attractive \$13,295 and offers a 10M byte hard disk option.

PROFILE: WANG 2200VP

Price as tested = \$20,700*

BENCHMARK STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2	✓											
I/O	B-2								✓				
SCI/ENG	C-1	✓											
NEW PROD	C-2	✓											
ACC REC	C-3			✓									
EDIT	E-1				✓								
		Excellent			Good			Fair			Poor		

COMMENT:

Wang's 2200VP was the only computer to capture three first places. The most impressive "first" was in the scientific/ engineering problem, where the 2200VP was almost twice as fast as its nearest competitor (HP's 250) - and three other systems could not perform the run at all. Superior number-crunching capabilities were also demonstrated in the CPU-intensive and the new product problem. Poorest results were displayed in the I/O-intensive test, the only run which was rated in the third quartile.

BEST FEATURES.....Users characterize the 2200VP as a "dream machine" which offers programmers a great deal of control, almost at the systems programming level. Especially lauded were the 32 special function keys which can be programmer-defined; the well-supported BASIC language interpreter hardwired in ROM; and the great ease of writing, debugging and modifying programs. In operation the 2200VP handles complex calculations with great ease, speed and precision.

DRAWBACKS.....Wang's method of file handling - addressing disk storage at the absolute sector level - will not satisfy users accustomed to having most data management done for them. While technically-oriented users found this method to be the "ultimate" in I/O efficiency, most end users reported that only customized software provided the file management they expected.

* UPDATE:

A recent price reduction in the CPU (from \$10,200 to \$7,000) would reduce this configuration's cost to \$17,500. Wang has also announced a new terminal with enhanced graphics capabilities that may be used with the 2200VP, as well as a fixed/removable hard disk drive available with 26.9, 53.8 or 80.8 megabytes of storage.

PROFILE: HEWLETT-PACKARD SYSTEM 45 *

Price as tested = \$23,650

BENCHMARK
STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2			✓									
I/O	B-2		✓										
SCI/ENG	C-1			✓									
NEW PROD	C-2		✓										
ACC REC	C-3								✓				
EDIT	E-1							✓					
		Excellent			Good			Fair			Poor		

COMMENT:

With four results placed in the first quartile, HP's system 45 demonstrated overall excellence in the benchmark runs. In two runs, HP was its own strongest competitor: System 45 took a second place to the HP250 in the I/O-intensive run, and was third to the 250's second place in the CPU-intensive run. Worst results fell into the third quartile for the edit test and accounts receivable problem.

BEST FEATURES.....System 45 is a truly portable "desk top" computer which offers some powerful hardwired features: a highly enhanced BASIC language, extensive CRT graphics, a built-in thermal printer and plug-in capability of adding ROMs for graphics, mass storage and I/O. Users of the compact 45 reported that the hardware was dependable and downtime was minimal.

DRAWBACKS.....RDC discovered no problems with System 45 during the benchmark process, so only its relatively high price (compared to other systems tested) was noted as a possible negative factor for users. During the RDC survey respondents from the scientific community complained of a lack of software and documentation to support the peripheral instruments they used in a laboratory environment.

*UPDATE:

HP is now marketing System 45B, an enhanced version of the system tested, which offers the following features: memory expansion to 449K bytes, an improved operating system, increased expansion potential, expanded applications software and keyboards in other languages. Current System 45 owners can use an "upgrade kit" to add these enhancements.

PROFILE: TEXAS INSTRUMENTS FS990/10

Price as tested = \$16,745

BENCHMARK
STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2						✓						
I/O	B-2				✓								
SCI/ENG	C-1	*	*	*	*	*	*	*	*	*	*	*	*
NEW PROD	C-2							✓					
ACC REC	C-3		✓										
EDIT	E-1			✓									
		Excellent			Good			Fair			Poor		

COMMENT:

* The current BASIC language and operating system software take up so much overhead that the FS990/10 could not run the scientific/engineering problem. See alternate results (C-1A) on page 11.

The FS990/10 made its strongest showing in the accounts receivable problem, second only to its own DS990 Model 2. Its poorest test was the new product problem, which dropped to the third quartile.

BEST FEATURES...Strong and dependable hardware packaged modularly by components for vertical expansion was cited by the FS990/10 users as outstanding features. The RDC survey primarily addressed technical users who were experiencing great success in using their TI minicomputer as a development tool to design applications software. Other points mentioned were the cost-effectiveness of the system and the outstanding field repair service.

DRAWBACKS.....TI does not directly supply software applications packages, so users must seek this support from TI's OEMs. Since software development costs can be a significant factor, end users are advised to investigate this area carefully to see how well their local OEM can supply their needs.

UPDATE:

Texas Instruments has announced the following software enhancements for the FS990/10: improvements to FORTRAN to include Math/Stat capabilities, and the availability of PASCAL as a run-time option.

PROFILE: DEC PDP-11V03

Price as tested = \$14,930

BENCHMARK
STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2				✓								
I/O	B-2			✓									
SCI/ENG	C-1							✓					
NEW PROD	C-2										✓		
ACC REC	C-3					✓							
EDIT	E-1									✓			
		Excellent			Good			Fair			Poor		

COMMENT:

Only HP's two systems in this series had better I/O results than DEC's PDP-11V03. Second quartile results for the CPU and accounts receivable problems were also stronger than more than half the other systems. The scientific/engineering problem scored at the highest end of the third quartile. Falling back into the lowest quartile were results for the new product problem.

BEST FEATURES....For some users, price tag alone is enough reason to consider the PDP-11V03. A lot of reliable hardware for the money and an extensive line of peripherals are salient DEC features. Users are assured that development efforts in applications will not be wasted due to the upward compatibility that DEC has built into the PDP-11 "family of products."

DRAWBACKS.....Because of the key role the OEM plays in Digital's organization, the end user is heavily dependent on the local supplier for all support services; therefore, a user's OEM assumes equal importance with the DEC product itself.

As the smallest member of the DEC PDP-11 family, the 11V03's memory capacity of 64K bytes is its absolute limit - it has no add-on memory flexibility offered by many other minis in this series.

PROFILE: RANDAL 100

Price as tested = \$17,850*

BENCHMARK STANDINGS. . .		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2								✓				
I/O	B-2										✓		
SCI/ENG	C-1						✓						
NEW PROD	C-2									✓			
ACC REC	C-3										✓		
EDIT	E-1												✓
		Excellent			Good			Fair			Poor		

COMMENT:

Randal's best showing was second-quartile placement in the scientific/engineering problem. Both CPU-intensive and new product problems dropped into the third quartile, with I/O-intensive and accounts receivable at the top of the last quartile group. Editing was tedious.

BEST FEATURES.....Along with the 100 minicomputer, Randal supplies a complete line of applications software for basic business needs. This hardware/software package approach appeals to users who seek a turnkey system requiring only operational skills. Users report that the Randal 100 hardware holds up reliably under heavy usage in a production mode.

DRAWBACKS.....Overall, the Randal 100's performance in the benchmarks would not satisfy users with a high requirement for speed.

In the RDC survey user satisfaction/dissatisfaction was directly related to the Randal distributor who supplied the customer interface. Therefore, users' assessment of documentation and repair services was variable.

*UPDATE:

Randal is no longer marketing the 125 lpm printer used in the RDC tests. The price of the configuration without this printer is \$16,150, to which the user would add either of two new printers: a 60 cps, 22 lpm printer for \$1,375; or a 180 cps, bi-directional printer with an average 210 lpm for \$2,795.

PROFILE: SPERRY-UNIVAC BC/7-610

Price as tested = \$25,450

BENCHMARK
STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2									✓			
I/O	B-2												✓
SCI/ENG	C-1					✓							
NEW PROD	C-2											✓	
ACC REC	C-3											✓	
EDIT	E-1											✓	
		Excellent			Good			Fair			Poor		

COMMENT:

All benchmarks were run in RPGII instead of BASIC and include compile time.

Strongest showing was second-quartile placement in the scientific/engineering problem. All other results were well below the median, with the poorest outcome being last place in the I/O-intensive test.

BEST FEATURES.....Since Sperry Univac has developed its BC/7-610 as a total hardware-software-service package, it offers a comprehensive and flexible line of software for business applications. A utility known as PIXIE allows end users to modify these applications to suit individual needs. Sperry Univac's sales and service forces were given outstanding ratings by the users surveyed by RDC.

DRAWBACKS.....Given that the BC/7-610 is one of the highest priced systems in this series and yet performed poorly in the benchmarks, it cannot be rated cost-effective in comparison to the other units tested. In addition, the BC/7-610 does not support a recognized higher level language that could be used easily by the end user community.

UPDATE:

Sperry Univac continues to expand the BC/7 series at the top end of the line so that BC/7-610 users can easily upgrade to accommodate increasing needs. Applications recently added are: Special Trade Contractors Accounting and Management System, and packages for three distributors - electrical/electronic, tires and lumber dealers. In addition, a new marketing thrust will include OEMs as third-party dealers.

PROFILE: Q1 LITE

Price as tested = \$20,500

BENCHMARK STANDINGS. . .		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2											✓	
I/O	B-2							✓					
SCI/ENG	C-1				✓								
NEW PROD	C-2						✓						
ACC REC	C-3							✓					
EDIT	E-1						✓						
		Excellent			Good			Fair			Poor		

COMMENT: All benchmarks were run in PL/1 instead of BASIC and include compile time.

Best placement for Q1 Lite was second quartile results for the scientific/engineering and new product problems. Two other results fell just below the median, taking seventh place in both the I/O-intensive and accounts receivable problems. Q1's poorest outcome was next-to-last placement in the CPU-intensive test.

BEST FEATURES....Approachable and easy to operate for the novice, the Q1 Lite offers a compact system which can satisfy both data processing and word processing needs. Q1 Lite's compiled PL/1 language was rated good for program development, even for inexperienced programmers. Q1 Corporation takes the hardware/software "complete package" approach, with special success in marketing an application for credit unions. In the RDC survey, users were enthusiastic about the responsive and personalized attention they continued to receive from the Corporation.

DRAWBACKS.....The 40-character screen width - half the size of most CRTs in this series - may prove distracting to users accustomed to a fuller display.

In the area of documentation users gave Q1 Corporation only fair to poor ratings - the one weak point of support services. Also, since the Corporation's field support generally centers around the New York City metro area and Federal installations in California and Washington, D.C., users in other locales should check local references carefully.

PROFILE: NTSC 405

Price as tested = \$15,500

BENCHMARK
STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2												✓
I/O	B-2										✓		
SCI/ENG	C-1	*	*	*	*	*	*	*	*	*	*	*	*
NEW PROD	C-2	*	*	*	*	*	*	*	*	*	*	*	*
ACC REC	C-3	*	*	*	*	*	*	*	*	*	*	*	*
EDIT	E-1								✓				
		Excellent			Good			Fair			Poor		

COMMENT:

All benchmarks were run in a compiled BASIC, so these results include compile time. In the two runs which could be performed, the 405 gave disappointing fourth quartile results, with a last place in the CPU-intensive problem.

Of the three programs which could not be reported, the 405 ran out of memory for the scientific/engineering problem, and could not be formatted with output to the screen for the new product and accounts receivable problems. For alternate results (C-1A, C-2A and C-3A), see page 11.

BEST FEATURES....The NTSC 405's price was among the lowest in the series. Although the 405 performed poorly in the RDC benchmarks, users in the RDC survey gave it good reviews when used as an intelligent terminal for data collection and on-site input. A wide range of communications options is available to accommodate distributed networks. Also, for those who enjoy using COBOL, it is offered as an option on the 405.

DRAWBACKS.....Obviously the 405 did not show many powerful capabilities in the RDC tests. Not only was the system slow, but it could not handle several of the benchmark requirements. The 405 offers few hardware options for flexible use, and NTSC does not support applications software directly - packages are developed instead by independent distributors who must be evaluated separately.

PROFILE: HEWLETT-PACKARD 250

Price as tested = \$23,400

BENCHMARK
STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2		✓										
I/O	B-2	✓											
SCI/ENG	C-1		✓										
NEW PROD	C-2			✓									
ACC REC	C-3						✓						
EDIT	E-1	✓											
		Excellent			Good			Fair			Poor		

COMMENT:

With five out of six results in the first quartile - and two "first places" - HP's 250 demonstrated overall excellence in these benchmark tests. Even the HP 250's poorest showing was above the median - a sixth place in the accounts receivable problem. Editing was first-rate.

BEST FEATURES....In addition to outstanding performance, HP's 250 offers an attractive desk-console unit which is "human-engineered" for ease of use. Special features include the CRT unit, mounted on an adjustable swivel for comfortable viewing, and "soft keys" on the bottom of the CRT to guide the operator through program steps. A feature unique to the 250 in this series, the soft keys made operating the system practically "fail-proof." Excellent programming tools include an enhanced BASIC language and a powerful operating system.

HP's IMAGE/250 data base management system was praised by its users. The hardware was characterized as reliable and easy to upgrade - memory to a maximum of 288K, a total of three disk drives plus a hard disk capacity, and up to five remote terminals.

DRAWBACKS.....Potential customers looking for a bargain may be put off by the 250's price, which was in the highest quartile of the twelve systems tested.

PROFILE: TEXAS INSTRUMENTS DS990 Model 2

Price as tested = \$16,030

BENCHMARK
STANDINGS. . .

		1	2	3	4	5	6	7	8	9	10	11	12
CPU	A-2							✓					
I/O	B-2					✓							
SCI/ENG	C-1	*	*	*	*	*	*	*	*	*	*	*	*
NEW PROD	C-2					✓							
ACC REC	C-3	✓											
EDIT	E-1		✓										
		Excellent			Good			Fair			Poor		

COMMENT:

**As with the FS990/10, this TI system uses so much memory with the BASIC language and operating system that the scientific/engineering problem could not be run. See alternate results (C1-A) on page 11.*

With only the CPU-intensive result below the median, the DS990 Model 2 split other results between the second and first quartiles. The strongest result was a first place for the accounts receivable problem.

BEST FEATURES....With Model 2 users can enter the DS990 family at a reasonable price and be assured that compatible software will enable them to upgrade within the series. Especially attractive features are the availability of a hard disk option and the ability to have single as well as multi-user operations.

DRAWBACKS.....Due to the high overhead of the TX5 operating system and BASIC language, OEMs report that program development on the Model 2 is constricted by the limited memory available.

Because the DS990 Model 2 is such a newly-released product, RDC could not conduct the usual survey of end users. Therefore, in-depth comments on actual usage of Model 2 in the field were not available for publication.

CONCLUSIONS

If you've turned to the back of this report looking for "the best" system neatly rated as "number 1" with the other eleven in descending order . . . you are going to be disappointed.

The truth is that each of the systems included in this series could be "the best" for a particular user - because "the best" is relative to the individual requirements of a given user.

This is the first important question that every potential buyer should ask himself: Is there a "match" between my requirements and the features that a vendor's system offers? If the answer to this primary question is "yes," then you are ready to evaluate whether or not the system's price/performance merits your investment.

One of the important revelations of this series is the realization that similarly configured systems can vary widely in the specific hardware/software features they offer and the performance they deliver. For example, several systems quoted 64K bytes as the maximum memory of the system; three systems in this category were DEC's PDP-11V03 and the Texas Instruments systems, FS990/10 and DS990 Model 2. The DEC system was able to handle the scientific/engineering problem (C-1) with no difficulty and came in just below the median in results; however, neither of the Texas Instruments systems had enough memory to load this larger problem. Why? Because TI's systems software and BASIC language took up so much memory that only minimal space for programs was left.

So we have this word of caution for prospective buyers: if the vendor does not quote memory in terms of "user memory," then probe beyond the standard memory specification to determine just how much room is available for your programs.

Is memory differential really significant to an end user? That depends entirely on what kind of end user you are. If you are delivered a "turnkey" system which the OEM has designed to meet your needs and which needs little in the way of programming, then the system's memory limitations are not a day-to-day concern. On the other hand, if you are the do-it-yourself type who wishes to dabble in program development, then memory limitations may become a frustrating obstacle. Or, if you wish to keep options open for future growth needs, a memory limitation

may hamper your plans. The answer to the memory question really is contingent on your style of operation - the requirements that you set forth in your initial criteria.

The element of a user's style entered into the development of each issue in this Benchmark Report series. This style factor was discovered as RDC talked to end users during the surveys for each system. Although these surveys included a limited number of contacts, a definable pattern of user and usage managed to break through during the interviews. In broad generalities, the IBM user chose a play-safe, no-risk system; the Datapoint user valued the many options that allowed him a mix-and-match approach; the Wang user was intrigued with the programming possibilities; HP users put a premium on performance and were definitely not bargain-hunters; Randal users were almost always "first time" users who felt comfortable with that vendor's "total package" offering.

Not only is your style of usage an important factor to consider (the old "know-thyself" rule), but the vendor's style of operation is a critical area needing thorough evaluation. Note that a whole "decision triangle" is devoted to profiling the vendor - his ability to provide the kind of support services you require, his method of distributing the product, and local references from other users whose needs are like yours.

One of the "hot buttons" of the user survey was the issue of support services. Once the buying decision has been made and the small computer system resides in-house, the vendor's handling of support services becomes a basic, ongoing concern. Does the vendor supply clear, easy-to-use manuals and guides for programming and operating? And how much documentation does the user need, anyway? RDC received as many complaints about voluminous documents poorly cross-referenced (from IBM users) as gripes about lack of documentation for peripherals (HP 45 users). Some vendors only offer two or three small guides designed for the user/programmer (Randal systems and Q1 Lite) while Texas Instruments offers three types of manuals - for installation, operation and maintenance - in addition to BASIC programming guides.

If documentation fails to provide the necessary information, is there a hot line available for person-to-person communication? Ql Lite users reported the availability of personalized technical service well beyond the usual start-up period; Texas Instruments also received high marks for tech support, as did Sperry Univac.

Frustration with poor documentation, although prevalent, could not match feelings expressed about repair services. It was interesting for the RDC interviewer to discover how great a part was played by user expectations in this area. For some impatient metropolitan types, even the three-hour turnaround promised by IBM was less than satisfactory, while some lower-key country dwellers were patient enough to wait three days for a repair call. In addition to varying response times for repairs, vendors also differ greatly in how they perform repairs. Some keep a large stock of spare parts and just replace a faulty component on the spot in order to keep the customer's system in production. Others respond quickly by telephone to set a priority on the urgency of the problem before they appear on-site. However, conditions within each vendor's network vary so much from one locale to another that only local references from experienced users are a valid means of evaluating this aspect of support services.

References are also the only sure way of checking out the distribution setup that a vendor uses. Some vendors keep centralized control over software development, field service and documentation. Sperry Univac, IBM, Datapoint and Hewlett-Packard are basically organized to retain contact with the end user. In other cases, users interact almost exclusively with middlemen - OEMs (DEC and TI) or distributors (Randal). In this latter instance, user satisfaction/dissatisfaction depends completely on the local supplier - no matter how high the user may rate the vendor and his product, it is the end supplier who plays a critical role.

When you have achieved a comfortable feeling about the vendor's operating style, you can turn to the industry's chief anti-inflationary weapon - hardware! Good hardware keeps coming down in price - witness the first four systems in this series: all have announced price cuts within 1979. Some price cuts - notably

for IBM's 5110 - have been across-the-board reductions in each of the components (CPU, printer and disks). Wang's price change concentrated on the CPU, and it was a significant 31% (from \$10,200 to \$7,000). Datapoint effectively phased out the 1170 series in favor of a much cheaper but equivalent configuration in the new 1800 series (from \$20,330 to \$13,295 - a 35% reduction).

Moreover, good hardware keeps getting better as well as cheaper - for example, single-sided diskettes upgrade to double-sided, double-density diskettes for improved storage capacity. In the beginning of the series, only IBM had this technology available on the 5110; but within months Datapoint, Hewlett-Packard and Texas Instruments announced this technological advance in diskettes. Now this doubled capacity is almost a standard offering.

Storage has also been improved in the types of hard disks that are available. Only the IBM 5110 and NTSC's 405 fail to offer the hard disk option on their minicomputer. Most other vendors allow you to keep future options open in this area so that expanding requirements can be accommodated through the addition of compatible peripherals. Some vendors are noted for their extensive line of peripherals - for instance, DEC printers abound and show up in many of the standard configurations offered by other vendors. Other vendors, like Randal and IBM, recommend a particular set of components because they judge that many users are more comfortable with a package deal. Still others, such as Datapoint, are happy to offer the world of versatile, mix-and-match options to their customers.

How a vendor's hardware stacks up in comparison to competitors can only be judged in two ways: by checking out the system's reliability and repair record with experienced owners, and by running benchmarks to elicit comparative results. Benchmarks have been the heart of this series of reports, and through these tests RDC has determined for each system which features win accolades as outstanding offerings, which features are weak enough to be characterized as "drawbacks," and how the system as a whole compares to its competitors in its price/performance. As frequently stated by RDC, benchmarks are not the whole story - but if you perform an evaluation without benchmarks

you diminish your final judgment because your information will most certainly be incomplete. If the Benchmark Reports had to point to one accomplishment, it would be this: the series revealed that similarly configured small computer systems vary greatly in their performance, proving that there is a difference in hardware.

With hardware showing decreasing costs and increasing technological capabilities, users are recognizing that in many cases "software is the key" to their choice in a small computer system. Some users who use the term "software" mean applications software only - the programming package which provides the answer to their business or scientific work - whether it be accounting, inventory, data base management or monitoring instruments. Depending on the vendor's style of operation, the applications software is supplied either directly (by the vendor) or by third parties such as OEMs or distributors.

Some vendors adopt the "total package" approach which delivers a system to the user as a complete hardware/software package. Many users are more comfortable in dealing with a vendor who quotes a total dollar cost for "the solution" to their requirements. Randal and Sperry Univac take this marketing approach. Q1 Corporation has been particularly successful in establishing a thrust into credit unions through its applications software, and Hewlett-Packard's IMAGE/250 for data base management is also aiming for an application niche. The "total package" approach appeals to users who are looking for a turnkey operation, already built and ready to go with few modifications.

Users who feel that their needs are so specific that specialized applications will have to be developed have several choices: they can seek a system which is approachable for the novice and develop programs themselves; they can investigate the local OEMs to see what hardware can be tailored to suit their particular requirements; or they can buy the hardware and use the services of a software house.

Some vendors, like Datapoint, make an effort to supply a great abundance of compatible software for their users - almost everything is software implemented. As noted previously in the discussion about memory, a complete orientation toward software implementation tends to cut down the space available for user programs. Also, software implementation of higher-level math functions cannot compete in speed with hardwired systems. So the flexibility of software offerings must be weighed against the more dedicated (fixed) hardwired approach - again, according to your priorities.

In some areas of software, only "hands-on" use will convince a user if he likes the mode of operation of a machine. How does the operating system "speak" to you - is it a friendly, prompting system which guides you gently? Is editing a tedious chore, or full of short cuts which make it easy to use? Are you comfortable with the programming language, and does it enable you to keep improving and expanding your operations? In the RDC benchmark process, we made a special effort to report on the enhancements or deficiencies of the programming language as offered by each vendor. All BASICs are not the same, and other languages such as PL/I and RPGII have their proponents.

Your degree of interest in software other than applications packages will depend on your attitude toward computers in general. If you're intrigued by the prospect of using the machine's language, then programming tools will interest you; if not, you may decide to opt for a pre-defined system which allows little or no tampering by the end user.

So once again we get back to style of operation - your style of operation - the single most important factor in the evaluation process. The points suggested by the decision triangles remain unfocused until you set personal criteria which serve as the foundation of a small computer decision.

BENCHMARK REPORT

Vol. 1, No. 1 through No. 14 (12 reports plus 2 summaries) is available from the Association of Computer Users on a subscription basis. Members \$150/year, non-members \$190/year. Overseas subscribers add \$30 for airmail postage.

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ASSOCIATION OF COMPUTER USERS

P.O. Box 9003
Boulder, Colorado 80301
Tel. (303) 499-1722

REAL DECISIONS CORPORATION

111 High Ridge Road
Stamford, Connecticut 06905
Tel. (203) 329-2071